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ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

375 - **Agriculture in Crete.** — FRANCHET, L., in the *Revue Scientifique*, Year LVI, No. 3, pp. 75-81. Paris, February 2-9, 1918.

Crete is essentially an agricultural country, but cultivation there is still in a primitive state.

VINE GROWING. — Vine-growing, though remarkable in Crete, is much inferior to what it ought to be. The quality of the produce is entirely due to the exceptional climatic conditions and in no wise to the work of the growers. There are many varieties of grapes but the principal and only really appreciated ones are:—

Black grapes: — Cotzifalei, Mendillarei; Liatico.

White grapes: — Rasaccia, Croutakta, Sultanine.

The wine is of medium quality only, owing to inadequate methods of preparation, for it could be excellent. The best red wine is made from the Cotzifalei grapes. Wine made with Mendillarei grapes is less alcoholic than the former, whereas that made with Liatico grapes is more alcoholic; it is also less dark than that made with other red varieties.

Of the white grapes, Rasaccia is chiefly used as a dessert grape, and Croutakta for wine-making.

The Cretan wines would be excellent dessert wines, of the Marsala type. The production of wine is estimated at 2 970 000 imperial gallons; it could easily be increased tenfold. Certain wines have, on an average, 14 to 16°, but some occasionally are as high as 17°, and even 19°, according to the year.

Crete exports raisins, but in small quantities only. For this purpose the Croutakta variety is chiefly used, and prepared as follows: — the grapes are steeped for some hours in a solution of carbonate of soda, then left to

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dry. They are generally sold only loose, the peduncle having been detached by the worker (women usually do this work) with her teeth. This method was the only one in use in Crete and Asia Minor till about 1910, but nowadays the peduncle is usually removed by machine. These raisins are exported and used in pastry-making, especially in Germany and Austria. The yellowish Sultanine variety, also known as "Corinthian", is also harvested. The peduncle is removed by machine and the raisins exported to Germany, Austria and Egypt.

The wine, residue and dried grapes are treated locally for the manufacture of alcohol, which is used in the country, the surplus being exported to the East. The annual production is from 352 000 to 396 000 gallons. The reddish alcohols, obtained by simple distillation, differ greatly in degrees, varying from 30 to 90°. The standard of the cognacs is from 38 to 45°.

Experiments on the manufacture of alcohol with locust-beans have not given satisfactory results.

CEREALS. — The cultivation of cereals is practically non-existent. The few natives and Turks who cultivate fields grow wheat and barley for their own use. The methods have remained unchanged for about 4 000 years. When the rich Messara plain is cultivated by modern methods it will yield sufficient wheat to supply the whole island with flour. At the present day about 12 000 metric tons of flour of different qualities are imported from Italy, Rumania and Bulgaria.

OLIVE TREES. — Olive trees, which grow with great ease in Crete, might prove one of the principal crops; in spite of the neglected condition of the trees they give an abundant yield. King George I made an attempt to improve the cultivation of olives by bringing specialists over from Italy to teach peasants the art of pruning. Unfortunately this experiment did not continue, and owners of olive orchards not only continue to neglect their tree, to the great detriment of the yield and quality of the fruit, but also to cut them for use as firewood, without considering the wealth they are gradually destroying.

The olives of Crete are of three qualities: — the *psiloeilies*, small olives yielding a good oil, the *chondroelies*, large olives giving a less appreciated oil, and the *tsounates*, medium olives very rich in oil, but of which, unfortunately, there are only a few in the island. The harvest is from October to November.

When ripe the olives are not picked or knocked down with a pole, but left till they drop. Often they are not collected from the ground till partly rotten. The oil is extracted by crushing, but there are three factories which extract oil from the cake by the carbon bisulphide method. The yield is very variable, varying from 5 to 15 %.

The residue from the bisulphide treatment is thrown away, though since it still contains 71 % of organic matter, it could be used as a fertilizer. A very small quantity of the olive oil is used for soap-making. The annual yield is about 5 500 000 lbs., only $\frac{1}{7}$ of the yield about forty years

ago. This industry, in which primitive methods are still used, could develop largely if modern methods and material were employed.

CITRONS. — The citron, grown in the positions best exposed to the sun and sheltered from the north wind, yields abundantly. The fruit is gathered in August and December, and exported chiefly to the United States, England and Germany. Unfortunately the trees are subject to many diseases which do great damage, especially when the wood splits and the sap flows.

The fruit is not exported fresh, as it would not stand so long a journey, but is put in brine. It is cut into two or three, placed in barrels, and left to soak in sea-water with a large quantity of salt. It is left thus for several weeks, then taken out and sorted into two or three qualities. The pieces are then put back into the barrels, and well pressed. When the bottom of the barrel has been fixed, a hole is made in it and a new, very strong brine introduced. The barrel is then hermetically closed and is ready for export.

TOBACCO. — The climate, as well as the soil of Crete, are very favourable to tobacco growing. It was started seriously in 1899, and in 1901 the yield had risen from 33 000 lb. to 275 000 lb. When, however, the Greek Government took over the monopoly of tobacco, the native crop was completely ruined, and today only very medium tobacco imported from Greece or Turkey is used in the island.

The native tobacco itself is not good, but this is due solely to the method of preparing it; if well cultivated and well prepared, Cretan tobacco could rank with that of the best quality.

VARIOUS FRUITS. — Crete produces lemons, tangerines which are much appreciated, cherries, and apricots; the Japanese medlar does particularly well there. When the soil is treated by modern methods fruit production may become of considerable importance.

STOCK BREEDING. — Properly speaking stock breeding does not exist in Crete, and the flocks of sheep or goats belong to peasants who keep them for their own consumption, selling only the surplus. The rare oxen or cows are kept only as draught animals, for the Cretans do not like cows' milk and hardly drink goat's or sheep's milk. The little milk drunk in the towns is almost exclusively imported concentrated milk.

Goat and sheep's milk are used in the manufacture of inferior quality cheese, which turns rancid rapidly. The Cretans however, excel in the making of "yoghurt", curdled sheep's milk, a large quantity of which is consumed locally, and is also exported to Turkey and the coast of Asia Minor; Cretan yoghurt is famous in the East. Butter is not made, food being prepared with oil.

Cattle breeding could be successfully attempted, especially in the eastern part of the island, and should give very good results. If goats and sheep were bred rationally they might prove a source of great profit and permit the utilisation of the uncultivated mountainous parts of the island.

376 - **Agriculture and Forestry in Cyprus.** — MIDDLETON J. P., in *The Quarterly Review*, No. 451, pp. 401-423. London, 1917.

AGRICULTURE. — The cultivation of cereals on primitive lines is essentially the principal industry of the island; most of the land is held by the peasants as proprietors, but in some places the métayer system prevails. There are about 1 100 000 acres of cultivated land, and it is estimated that some 325 000 acres are still susceptible of cultivation.

A Department of Agriculture, staffed by a Director and other Assistants, including a veterinary surgeon, is endeavouring with some success to induce the farmers to adopt the use of manures and improved implements and systems. An experimental farm, started in 1903, was in 1907 converted into a stock and horse-breeding establishment, by means of which the general standard of stock and the native ponies have been much improved. The Government has also started ostrich breeding, an experiment so far not attended with quite the success anticipated. Cattle, horses, sheep, pigs and poultry, however, show, by their improvement in character and value, the wisdom of the Government efforts.

The cultivation of the vine, which extends over a large area, produces red and white wines of various types, forming one of the main staples of Cyprus trade. The application of sulphur to the vines has been made compulsory, and the extension of vine disease has thus been greatly lessened. The manufacture of wine is still generally primitive, but an English company, established for some twenty years, buys up the peasants' grapes and makes wine of a better character. Excellent brandy is also manufactured at Limassol. The value of wine exported in 1879 was £31 600; in 1880 it reached £46 000, rose to £53 685 in 1911, but fell again to £43 060 in 1913. These figures do not show any great increase in the output of wine, but there seems to have been a considerable extension in the production of raisins in later years, for whereas, in 1911 the value of raisins exported amounted to £29 636, it increased in 1913 to £39 002. This seems to show that it pays better to transform the splendid black grape of Cyprus into dried fruit than to manufacture wine.

Irrigation, as a Government undertaking has not apparently been attended with the success expected, partly owing to the thrifty habits of the peasants who wait for rain until the last moment; and partly owing to the evaporation consequent on summer storage. It appears that only some 600 acres of summer crop in the shape of cotton are grown. The peasants have their own rough methods of irrigation. There is no doubt that irrigation works wonders on the arid surface of the soil and amply repays its cost. Convinced of this the Government formed its first reservoir at Sykkrasi and others have since been completed. But the system of storage irrigation does not seem to commend itself to the villagers; and reclaimed lands attached to the reservoirs are but slowly taken up. In one of the reservoirs also the water has proved brackish and unsuitable for watering crops. The State only takes a "small fraction of the total increased production", while a considerable outlay is involved in paying compensation for land; the prospect of financial success is therefore uncertain at present.

Cyprus has suffered from the plague of locusts from time immemorial; and remedies for it engaged the attention of the English Government soon after the occupation. Each year the "screen and pit" method suggested by M. MATTEI has been applied; and by means of this plan and by purchase of the eggs and the insects themselves at the suitable seasons the scourge was practically eradicated, but at a considerable expenditure, which was met by a Locust Tax. The surplus funds arising from this tax, which was in existence for some years, have afforded a convenient reservoir for unexpected emergencies. In later years, on a recrudescence of the plague, treatment by means of noxious chemicals has been tried, but met with objection from the peasants. A compromise has been effected under which this treatment is only applied to places where there is no risk to the animals of the villagers, while the old system of purchasing eggs and insects in their immature stage is resorted to elsewhere.

FORESTRY. — In ancient days Cyprus was no doubt rich in timber, and its mountain districts were clothed with trees varying with the altitude. In 1878, when Cyprus passed under British control, the condition of the so-called forests was deplorable, and it was clear that strong steps, aided by scientific knowledge and a Government Department, must at once be taken to remedy and stop the cause of destruction. An Ordinance was passed in 1879 for the delimitation and preservation of the forests; and successive Forest Officers sought to remedy some of the abuses by prosecution in the Courts, while the forest areas were gradually delimited and settled. They now extend to some 700 square miles.

The trees consist principally of the Aleppo pine, but, at an elevation of 4000 ft. and over, of *Pinus Laricio*. Large tracts are also covered with *Quercus alnifolia*, which is much in demand for making native ploughs and carts, while *Arbutus* flourishes in many places on the slopes of the hills and is used in the manufacture of rough furniture.

With very small sums voted annually to the Department, protection was the only course open to those in charge; and no progress in artificial reforestation was made till many years after the occupation. Since 1907 special tree-planting has made considerable progress, some 300 miles of fire-paths have been made, and goats will gradually be excluded altogether by means of legislation passed in 1913 on the principle of local option for each village. The police protection has on the whole always been good, and there is no doubt that the forests of Cyprus are now in a fair way to recovery, and are likely to become an added source of beauty and prosperity to the island. It may be interesting to note in this connection that the rainfall appears of late years to have increased.

377 — A Biological Analysis of Pellagra-producing Diets. II, The Minimum Requirements of the Two Unidentified Dietary Factors for Maintenance as Contrasted with Growth (1). — MCCOLLUM, E. V. and SIMMONDS, N., in *The Journal of Biological Chemistry*, Vol. XXXII, No. 2, pp. 181-194 + 6 diagrams. Baltimore, Nov., 1917.

The authors draw attention to the fact that the previous experiments carried out at the Laboratory of Agricultural Chemistry of the University

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(1) For a review of the first part of this study see *R.* Jan., 1918, No. 2. (Ed.)

of Wisconsin, Madison, proved that of the four "deficiency diseases" — beri-beri or polyneuritis, scurvy, rickets and pellagra — caused, according to FUNK, by the absence of vitamins, only beri-beri can be called a "deficiency disease", in the sense the term is used by FUNK (*i. e.* caused especially by the deficiency of the water-soluble B), the other three being due to unsatisfactory relationships between the well recognised constituents of the normal diet. To polyneuritis must now be added another "deficiency disease", xerophthalmia, described in Japan by M. MORI (*Jahrbuch für Kinderheilkunde*, Vol. LIX, p. 175, 1904), in Denmark by G. E. BLOCH (*Ugeskrift for Læger*, Vol. LXXIX, p. 349, 1917), and in Germany by A. CZEKNY and A. KELLER (*Des Kindes*, Leipzig, 1906, Pt. 2, p. 67). This disease appears in children fed on a diet too rich in cereals and too poor in fats, and is manifest by emaciation accompanied by xerosis of the conjunctiva and keratomalacia, often ending in blindness. Experiments at the University of Wisconsin have shown that a diet deficient in the fat-soluble A causes, in animals, emaciation, oedema of the eyes, blindness and death. The animals may be cured, even when dying, by administering fats rich in the fat-soluble A (1), xerophthalmia being attributed to a lack of this factor in the composition of the diet.

The aim of the experiments described in this paper was to ascertain the quantity of each of the two unidentified dietary factors, A and B, necessary to the maintenance and growth of young rats. Wheat germ was chosen as source of the water-soluble B, and butter fat as that of the fat-soluble A. The diet was known to suffice for normal growth and prolonged maintenance of health when an adequate supply of both of the unidentified essentials was furnished. The diet consisted of: — casein 18.0, dextrin 76.3, salt mixture 3.7, agar-agar 2.0 %. It was fed: — a) with an abundance of fat-soluble A (as butter fat); b) with an abundance of water-soluble B (in wheat germ); c) with varying amounts, always below the optimum requirements, of both wheat germ and butter fat as sources of these two factors.

The results of the different experiments gave the following answers to the various questions raised: —

1) Assuming each of the food products, butter fat and wheat germ, to be of constant quality, what is the lowest intake of each which can supply enough of the A and B respectively just to prevent loss of weight? — The results show that a low plane of intake causes loss of vitality. When the minimum amount necessary to prevent loss of weight is approached, the life of the animal is endangered if the diet is persisted in.

2) When both essentials A and B are supplied in amounts just above the maintenance requirements will growth be proportional to these amounts

(1) The fat-soluble A is found in fats of animal origin, such as the fats of butter and egg, and the fats extracted from internal organs (kidney, liver, etc.); it is abundant in leaves and in very few seeds (flax and millet); it is very scarce in animal body fats and absent in vegetable oils and fats. (*Journal of Biological Chemistry*, 1913, Vol. XV, p. 167; Vol. XVI p. 123; *American Journal of Physiology*, Vol. XLI, p. 361, 1916 (Author.)

or is a certain excess of each over this minimum necessary before growth in the young can take place? — The results show that, within certain limits, growth is proportional to the supply of the factors A and B in the diet, if all other factors are in proper proportion. For this reason the individual behaviour of the organisms to which these factors are administered cannot be eliminated.

3) Is the requirement of either A or B for maintenance or growth less when one of the two unknowns is present in liberal amounts, than when both are supplied in amounts near the minimum? — The experiments showed definitely that the animal can tolerate small quantities of A and B much better when the rest of the diet is well proportioned than when it is well constituted.

4) What is the effect on the health of animals of limiting them to a minimum supply of either the dietary A or B, the remaining one being supplied in abundance, or of limiting the supply of both to nearly the minimum requirement? — The life of the animals is undermined and endangered if the experimental conditions are such as to render growth impossible. The symptoms preceding the death of rats are similar to the characteristic symptoms of polyneuritis in pigeons.

378 - **The Biological Efficiency of Potato Nitrogen.** — ROSE, MARY S. and COOPER, LENNA F. (Department of Nutrition, Teachers College, Columbia University, New York), in *The Journal of Biological Chemistry*, Vol. XXX, No. 2, pp. 201-204. Baltimore, June, 1917.

A woman was submitted for 10 days to a diet of potatoes and clarified butter, which was sufficient for the total calorific energy. In this diet the potatoes supplied 0.1 % of the total nitrogen and nitrogen balance was maintained for 7 days (from the 4th to the 10th day of the experiment), with a total nitrogen intake of 0.096 gm. per kilo of live weight, equivalent to a net intake of 0.068 gm. per kilo of live weight. This result agrees with those of other workers, in which nitrogen equilibrium was maintained on potato nitrogen when the amount taken was from 0.04 to 0.08 gm. per kilo, and shows that the potato is a source of nitrogen of high food value, although only 63 % of the nitrogen is in the form of protein.

379 - **Food Value of Wholemeal and of 85 % Flour as Compared with White Flour.** — LAPICQUE, L. and CHAUSSIN, J., in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 7, pp. 300-302. Paris, February 18, 1918.

The authors carried out a series of systematic experiments to determine the value of 80 and 85 % flours.

1) — **FOOD VALUE OF WHOLEMEAL.** — The experiments showed the food value of wholemeal to be slightly greater than that of its weight of white flour minus the weight of the indigestible residue. Average wheat gives 12 % of such residue and its food value is equal to 9⁸⁰/₁₀₀ of its weight of white flour. The so-called work lost by the mastication, mixing and intestinal transport of this excess of inert substances causes no deduction in this case as the figures are based on the value for the maintenance of the organism.

2) — **COMPARATIVE VALUE OF WHITE BREAD AND BREAD MADE WITH**

85 % FLOUR (treated with lime water) (1). — The difference in value between the two breads studied was too slight to be seen. With a mixed diet this difference could not be detected.

If the changes which may arise through the acidity of the bread (2) are eliminated, and the differences caused by the formation of hydrates are avoided or compensated for, 85 % bread has practically the same food value as white bread.

380 — **Toxic Bread and Flour; Detection and Estimation of Sapotoxins.** — STOECKLIN, L., in *Annales des Falsifications et des Fraudes*, Year X, Nos. 109-110, pp. 561-572, 1 fig., 2 Diagrams. Paris, November-December, 1917.

The 85 % war bread has again raised the serious question of injurious flours made from uncleaned or badly cleaned wheat which contain a large proportion of foreign grains, some of them very toxic. A long time ago, when cow-wheat was a very common weed, there was in France an epidemic which was attributed to the presence of this grain in the bread. Now there are cases of another disease caused by corn-cockle, which, however, is harmful in a different way from cow-wheat. The presence of 4 gm. of corn-cockle, *i. e.*, about 200 mgm. of sapotoxins (toxic glucosides of the "saponin" type), may cause very marked disorders in adult human beings. Animals are, as a rule, much less sensitive to the effects of corn-cockle than man; it has no effect on sheep or rabbits, and may be used as a normal food for them, but 250 gm. of it will kill a calf (3).

Of all the foreign grains liable to become mixed with wheat, corn-cockle is the most dangerous, the more so because, by reason of its similarity to wheat in weight and size, it is difficult to eliminate. Public bodies made the seriousness of this danger known as soon as 85 % flour came into use, and, by a circular letter addressed to the Director of the Laboratories of Adulteration, and another to the agents of the Service for the Prevention of Fraud (dated August 17, 1917), the Minister of Agriculture gave instructions for distinguishing flour from badly cleaned wheat and the penalties to be imposed on those responsible. These instructions order to seek for and retain as:—

1) fraud, being not of the nature and quality demanded of the article sold (a fraud dealt with by Article 1 of the law of August 1, 1905), all flour containing an excess of foreign, but not dangerous, grains;

2) "injurious to health", with application of the regulations of Article 3 of the law of August 1, 1905 (which orders imprisonment for a period of 3 months to 2 years, independently of a fine of 500 to 10,000 fr. (£20 to £397), flour containing impurities made up of dangerous grains the presence of which renders the flour toxic in the sense of the above-mentioned law.

It is easy to detect particles of corn-cockle in flour but a quantitative estimation is very difficult. The author based his method for the detection

(1) See R. Jan., 1918, No. 3, and Feb., 1918, No. 216. — (2) See R. March, 1918, No. 344. — (3) See also R., Nov. 1916, No. 1191. (Ed.)

and estimation of sapotoxins in flour on the capacity of the saponins to haemolyse red blood corpuscles (as in his research into the saponins of beer in 1911). His results were conclusive.

In toxicology the saponins are placed in the class of the so-called haematic" poisons which act on the corpuscles and plasma. They are poisons of the circulation, especially of the heart and nerves, capable of causing irritation of the mucous membranes and serious digestive troubles. The sapotoxins haemolyse the blood, *i. e.* destroy the globules with formation of red, perfectly clear and transparent liquid by the setting free and solution of the haemoglobin; it is an haemolysis caused by toxic injury.

The haemolytic reaction is specific for the detection of the sapotoxins in flour in an isotonic medium, *i. e.*, with a freezing point about 0.56° C. most satisfactory in 0.95 % physiological salt serums, in very small quantities at ordinary temperature, using an emulsion of blood corpuscles freed from fibre and plasma (natural antihæmolytins), and avoiding all accidental causes of hæmolysis (which may be controlled by making a test with a saponin-free flour).

REAGENTS. — Two reagents are required for the reaction : — 1) an artificial 0.95 % physiological serum ; 2) a 10 % blood emulsion (human blood, blood of oxen, sheep, horses or sheep) fulfilling the conditions given above.

METHOD : — I. DETECTION OF SAPOTOXINS IN FLOUR.

1) *Freeing the flour from fat* by extraction with dry ether.

2) *Extraction of sapotoxins* : — 1 hour in the hot-air oven at 100°, cooling, addition of physiological serum ; 1 hour at 40-45° with frequent shaking ; ½ hour in the centrifuge ; filtration.

3) *Hæmolytic reaction* : — the blood reagent is added to the extract obtained ; if the liquid becomes transparent sapotoxin is present ; the duration of the reaction varies from a few seconds to several hours, the more sapotoxin there is present, the shorter it is.

II. QUANTITATIVE DETERMINATION : — The rate of hæmolysis is dependent on : — 1) the concentration of the sapotoxins ; 2) the temperature of the reaction ; 3) the nature of the blood ; 4) the age and concentration of the blood emulsion. There is a mathematical relation, which may be expressed by a regular curve, between the speed and concentration, all other conditions being equal. The author has drawn up diagrams giving an idea of speed in relation to concentration which are often sufficiently approximate for practical use ; nevertheless, for an exact analysis, it is best for the worker to compare the types and draw his own curve.

1 - **The Prevention of Malta Fever by Active Immunisation of Animal Carriers.** — VINCENT, H., in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 8, pp. 350-362. Paris, February 25, 1918.

Malta fever, caused by *Micrococcus melitensis*, originally considered to be restricted to Malta and Gibraltar, is in reality found in many countries, particularly those bordering on the Mediterranean.

The animal which is most subject to this disease and most capable of transmitting it to man is the goat. There is every reason to believe that active immunisation of the goat by *M. melitensis* is possible. As a

rule this animal only shows slight morbid symptoms, although it harbours the pathogenic organism for a long period. On the other hand, it may recover spontaneously from the disease after a variable period and, when covered is immune. The author attempted to increase this natural resistance by vaccination with different strains of *M. melitensis*.

It is impossible to immunise the animals with a living virus, as this would cause infection amongst them; they must be vaccinated with a dead virus. The author prepared a polyvalent vaccine (gelatine cultures, 3 or 4 days old, diluted in physiological water, sterilised by shaking with ether and contact with it for 2 hours) with 10 strains of *M. melitensis* and one *M. paramelitensis*. The vaccine contained about two thousand million micrococci per cc. Two injections of 2 cc. each were made at intervals of 5 or 8 days. A description is given of the experiments.

More than 200 young and adult goats were vaccinated; they included—1) adult goats and he-goats; 2) kids 2 to 3 months old; 3) goats pregnant since 1 to 3 months; 4) goats in milk. No special symptoms were noted. After a few hours the injections caused a rise in temperature of 0.5 to 1°C. the following day the temperature was normal. The goats kept their appetite. Those in kid suffered no bad effects, and pregnancy was not influenced by the injections.

This method of immunising goats and other animals capable of transmitting Malta fever by their milk or excreta or by direct contagion, may have the double effect of protecting these animals and, indirectly, man himself, against this serious disease.

382 — **Loss of Power of Infection of Marsh Anopheles during Hibernation.**

ROCHAUD, R., in *Comptes-rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 6, pp. 264-266. Paris, February 11, 1918.

Recent experiments have shown that not only do the salivary glands of marsh anopheles lose their sporozoites after a relatively small number of punctures, but that the sporozoites, if they have not been ejected, slowly degenerate in the tissues of the glands or the saliva. A prolonged conservation of the power of infection in infected anopheles does not seem possible. Unlike trypanosomic infection by *Glossina*, which generally lasts till the death of the infected fly, the salivary plasmodic infection of anopheles is only temporary. The saliva of mosquitoes cannot, thus, be considered as an hibernation medium of malarial sporozoites.

EXPERIMENTAL
AND
ANALYTICAL
WORK

383 — **Electric Farming in the United States.** — MOULTON, ROBERT H., in *Harvard Magazine*, Vol. LIV, No. 23, pp. 797 and 816, 3 figs. Fort Atkinson, Wis., December 28, 1917.

Experiments on electric farming (1) were made under the direction of Dr. HERBERT G. DORSEY and Mr. F. M. TAIT near Dayton, Ohio (Miami River Valley).

In the preliminary tests small plots were subjected to different kinds of electrification. To prevent the soil of one plot from being better than that of another, top earth was collected, mixed, sifted and then laid to

(1) As regards Electric Farming, see *R.*, Jan., 1918, No. 10 (Ed.).

uniform depth of 7 inches over the whole area. In plot No. 1 was buried a wire screen, a wire network was stretched about 15 inches from the ground, and both connected by several wire antennae. The screen was connected to one terminal of a Tesla coil, and the network to the other. A transformer supplied an alternating current of from 110 to 5000 volts, charging a condenser of tinfoil and glass plate, which discharged through a primary of the coil. About 130 watts were supplied for an hour each morning and evening.

Plot No. 2 was lit by a 100 watt tungsten lamp with a ruby bulb for 12 hours daily, beginning from sunset. Plot No. 3 was lit in a similar way, but with a mercury vapour lamp. Plot No. 4 was untreated and served as control. In plot No. 5 was buried a wire network connected to the terminal of a 110-volt direct current. The positive terminal was attached to a small sprinkling can with a carbon electrode in its centre. The can was filled, the water electrolysed for several minutes, and the plot sprinkled with the water from the can, the theory being that the current should penetrate the soil in the water. Plots Nos. 6 and 7 were subdivided into four plots each 2 ft. square, separated by porcelain insulators and arranged with carbon electrodes at each end. Both direct and alternating currents were applied to these electrodes. Radishes and lettuce were sown and, when germination had begun, the different methods of electrification were tested with great care.

The plants in plot No. 1 grew much more rapidly than those of the other plots and weighed more than double those of the control bed. This convinced the experimenters that electrification of the ground by high-frequency currents stimulated plant life to an extent which justified a more complete investigation. Two acres of flat, rich ground were, consequently, selected for further tests.

Fifteen feet above the ground was built a network of sprinkling pipes, which ran east to west for a distance of 200 feet, the pipes being 50 feet apart. At the north-east corner, from north to south, were stretched 7 copper wires, each 200 feet long, at intervals of 15 feet. The wires were placed high enough for the soil to be ploughed with horses. The ends of the wire were attached to insulators on the top of gas pipes set in concrete. A small transformer house was built at the eastern end of the house and machinery capable of supplying 10 000 volts installed. A choke coil and a Tesla coil were used. The whole was so connected that the current from the wire network was sent by the antennae to the network of sprinkling pipes, which were adequately connected with the ground. Towards the end of July the system was ready and the currents tested. At that time a pressure of 50 000 volts was obtained and the frequency of the alternating currents was estimated at 30 000 cycles a second. Birds alighting on the wires were stunned and thrown to the ground, but none were killed. The ground was planted with dishes, lettuce, beet, cabbage, cucumbers, turnips, musk-melons, water-melons, parsnips, beans, peas, maize, and tobacco. All were planted in rows running from east to west, so that one half of each row was electrified and the other half not.

Practically all the plants in the electrified area grew more rapidly than those out of it. In nearly every case the electrified plants ripened a fortnight earlier than the untreated ones. The tobacco plants from the electrified area weighed, on the average, 1687 gm.; those of the unelectrified area, harvested two weeks later, only weighed 1632 gm. each. Considering that the tobacco plant grows most rapidly in the two weeks preceding ripening, it was estimated that the actual increase in weight of the plants in the electrified zone was 20 % more than that in the unelectrified zone.

Before electricity can be applied practically for stimulating plant growth many problems must be solved which are now being investigated in greenhouses in all parts of the United States. (The author draws attention to the experiments made by English workers who attempted to stimulate animal life by electricity. Two large incubators containing newly hatched chickens were taken, one being subjected to high-frequency currents, the other being used as a control. The chickens in the first incubator grew much more rapidly than the others).

Mr. W. STAHL, an electrician, used electricity on plants on one of his farms near Chicago. A network of wires, from 10 to 20 feet apart, was placed in the earth at a depth of about 1 ½ feet; above the ground was another network of wires about 1 foot apart. Twice a day, morning and evening, the electric current was turned on from the main switch-board. The power was supplied by the city electric light plant, and the cost for the period necessary to ripen a crop was \$ 2.50 to \$ 4.00 per acre. The electric treatment was started just when the plant began to come out of the ground and continued till the crops were about ready to be harvested. The cost of installation is repaid by the increase in crops, and the cost of the current is more than compensated for by the saving in the cost of labour, and the more rapid growth and harvesting of the crop.

In 1917, Mr. STAHL gave a demonstration of the electric treatment of plants on a two-acre plot of his farm. He grew beans, tomatoes, beets, melons and other vegetables, which ripened much earlier than those on neighbouring farms, and allowed a second crop to be ripened before winter. The electrified plants are distinguished by their excellent quality.

CROPS AND CULTIVATION

AGRICULTURAL
METEOROLOGY

384 - **Effect of Meteorological Factors on the Maturation of the Tissues and the Resistance to Cold of the Vine in U. S. A.** — GLADWIN, F. E., *New in York Agricultural Experiment Station, Bulletin No. 433*, pp. 107-139. New York, April, 1917.

During the spring of 1916 Concord vines, at Fredonia, Kentucky, suffered severely from frost; a large proportion of the buds were killed, and many of the shoots dried up later.

An examination of the effects of meteorological factors on the growth of the vine, seemed to prove that the real cause of the damage is not the low temperature of spring, but rather the climatic conditions of the previous year, which prevent both the buds and the wood from maturing completely.

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before winter; this may be seen from the low water content of the tissues and the thickening of the cell walls.

Abundant rain and high temperature up till the beginning of October followed by a sudden drop in temperature, are conditions favourable to good development of the tissues, which continue to produce thin-walled, turgid cells, until the sudden cold stops growth and brings about the winter stage before the buds and wood are mature. It is rare that all the buds mature completely; generally the first 5 or 6 on the base of the cane, and those near the apex are incompletely mature, and are clearly the most sensitive to adverse weather conditions, in winter and especially at the beginning of spring, *i. e.* when growth re-starts.

Maturity of the wood and buds is probably correlated with the ripeness of the fruit as measured by the sugar content of the juice. The meteorological conditions which determine complete ripening of the fruit also determine ripening of the fruit and buds. The 1914 crop was above the average, the grapes ripened completely, so did the plant tissues, as is shown by the low number of buds destroyed by the spring frosts. If the meteorological data of 1914 are compared with those of the year 1915-1916, two factors are seen:—

1) In 1915, many clouds, abundant rain and large number of wet days in August, September and October retarded evaporation, so that the soil was continually wet.

2) In 1915, September was much warmer than in 1914, a difference of 2° F. in the average daily temperature. The moisture of the soil and the warmth favoured late growth of the wood and retarded its ripening as well as that of the fruit.

3) In 1916, a high percentage of buds was destroyed in some varieties, whereas in others they were totally destroyed. The damage was not limited to certain districts but spread over the whole grape-belt. The abnormal warmth towards the end of January and the March frost alone would certainly not have had such disastrous effects if the incomplete maturity of the wood and the buds had not decreased the resistance of the plants to cold.

According to experiments made by the author, various types of fertilisers, nitrogenous, phosphatic and potassic, have no influence on maturity, and cannot, therefore, lessen the effect of low temperature.

To estimate the damage suffered during the season winter-spring 1916, 46 different vines were examined and the percentage of buds destroyed in each was calculated. All the plants were not damaged to the same extent and they could be divided into 3 groups as follows:

GROUP I. — *Least damaged vines*: 10 to 20 % of the buds destroyed: Mission, 10 % — Noah, 12 % — Cottage, 13 % — Moor Diamond, Hubbard, 14 % — Aroma, Dracut American, Woodruff, 15 % — Little Wonder, 16 % — Barry, 17 % — Concord, 18 % — Pocklington and Beta, 19 % — Martha, No. 261, 20 %.

GROUP II. — *Most damaged vines*: 80 to 100 % of the buds destroyed: Empire State and Dewdrop, 80 % — Brighton and Ontario, 82 % — Green Ear, 83 % — Diana, 86 % — Secretary, 88 % — Station No. 939, Dod Ridge, *Vitis Berlandieri*, 90 % — Ulster and Em-

model, 92 % — Delakins and Dutchess, 94 % — Isabella, 95 % — Captivator, 96 % — Lady Washington, Armalaga, Westfield, No. 3 516 : 99 % — Herbemont, Mills, Black Eagle, Rebecca, Nos. 267 and 268, 100 %.

GROUP III. — *All the other vines examined : 21 to 79 % of the buds destroyed.*

To what is the difference in susceptibility of the various vines due? First of all, it is seen that different varieties of the same species in no wise show the same degree of resistance. In the *Labrusca* varieties the damage varies from 13 % for the Cottage variety, to 78 % for Wyoming, the *Riparia* varieties vary from 12 % for Noah, to 88 % for Secretary, the *Aestivalis* varieties from 22 % for Wine King to 94 % for Dutchess. As a whole the *Aestivalis* group is more susceptible than the *Riparia* group or the *Labrusca* group, which is the most resistant. The *Labrusca* × *Vinifera* hybrids vary from 15 % for Woodruff to 100 % for Mills and Rebecca, the degree of resistance increasing in proportion as the characters of *Labrusca* predominate. It has been proved that, in New York State, the *Vinifera* varieties cannot survive the winter. Pure *Riparia* varieties have proved fairly resistant (Gloire, 29 % and Grand Feuilles 21 % of damage), and so have the *Ruprestis* varieties (St. George, 29 % ; Mission, 10 %).

The above data shows clearly that certain species, as well as certain varieties of the same species, are more resistant than others, and capable of ripening their wood and buds more rapidly. The texture of the wood varies in different species and varieties of vine, but, so far, there have been no investigations into the possible correlation of wood hardness and resistance to cold.

SOIL PHYSICS.
CHEMISTRY
AND
MICROBIOLOGY

385 — *Vegetation as an Indicator of the Fertility of Sandy Pine Plains Soils in Northern Wisconsin.* — DUNNEWALD, T. J., in the *Journal of the American Society of Agronomy*, Vol. X, No. 1 pp. 19-23, 5 tables, 1 diagram. Lancaster, Pa., January 20, 1915.

While making a survey of part of northern Wisconsin it was noticed that the soils of sandy plains varied considerably in their ability to produce a second growth after the removal of the pines and the many severe fires which succeeded logging operations.

The most sandy portions, where the original timber was sparse, or consisted chiefly of Norway pine (*Pinus resinosa*) and Jack pine (*P. Banksiana*), with, perhaps a few white pines (*P. Strobus*), now bear little or no second growth. Small Jack or Norway pines, 6 to 10 ft. high, appear in clumps and the poplar brush, if any, is also less than 10 ft. high, while a thick growth of sweetfern (*Myrrhis odorata*), bracken (*Pteris aquilina*), blueberries (*Vaccinium corymbosum*), or coarse bunch grass (*Elymus* sp.), is the only ground cover. In other places, where the moisture conditions appear somewhat better and the soil slightly more loamy, the second growth is often 20 to 40 ft. high, and consists of poplars, white birch, cherry, alder, and young white pine, with but few Jack or Norway pines. The original timber here had also been of better quality, mostly large white and Norway pines.

In this botanical examination of soils on the basis of their value for agricultural purposes, the most sandy soil was considered to be of low

value for farming, while the more loamy soil (indicated by the vegetation and better moisture conditions) was classed as fairly good. Typical samples were taken from widely-separated areas of these two soils, and mechanical and chemical analyses made. The results show that the soils with a small or sparse second growth should be classed as coarse or medium sand, whereas those with strong second growth should be classed as fine sand. The second type contains about the same amount of fine clay as the first, but much more silt and, particularly, much more fine sand. The averages of the principal fertilising elements in the different soils are given below:—

	Coarse sands			Loamy and fine sands		
	Phosphorus %	Potassium %	Nitrogen %	Phosphorus %	Potassium %	Nitrogen %
all (top 8 inches)	0.048	1.12	0.071	0.055	1.05	0.081
subsoil	0.032	1.06	0.037	0.037	1.13	0.035

The coarse sandy soils contain 0.82 % calcium, the loamy and fine sandy soils 1.16 %. It is seen that the greatest difference in the food elements of the soil of the two groups is in the phosphorus; both the types are poorer than other classes of soil containing finer material (clay and silt).

The moisture equivalent (determined by letting each sample absorb as much water as it will hold, then subjecting it to centrifugalisation at 440 revolutions per minute for 40 minutes, and determining the percentage of moisture after treatment) was:—*coarse sands*:—soil, 14.92; subsoil, 4.8; *loamy and fine sands*:—soil, 19.40, subsoil, 13.76; i. e. the fine sands exceed the coarse ones by about $\frac{1}{3}$ (27 %) for this important factor.

In conclusion it may be said that the undergrowth of cleared woodland is a good indication of the cropping capacity of the soil; heavier growth shows a higher content of plant food, the presence of more fine material in the soil, and especially a greater moisture-retaining capacity, enabling the vegetation to resist drought.

65 - **The Growth of Sheep Sorrel (*Rumex Acetosella*) in Calcareous and Dolomitic Media, in the United States.** — MACINTIRE, W. H., in the *Journal of the American Society of Agronomy*, Vol. X, No. 1, pp. 29-31, 1 plate. Lancaster, Pa., January 20, 1918.

The work described was carried out at the Agricultural Experiment Station of the University of Tennessee, by Dr. J. I. HARDY, under the direction of the author.

In 10 pots was placed a mixture of clean sand and limestone (92 % CaCO_3), and in 10 others a mixture of sand and dolomite (about 50 % CaCO_3 and 35 % MgCO_3). The percentages of limestone and dolomite used were 100, 75, 50, 25, 15, 5, 2.5, 1, 0.5, 0. Eight stolons of equal size were placed in each pot with lime on June 13, and harvested, with their roots, on September 22, 1913 (101 days of growth), and in each pot with dolomite on March 31, and harvested July 8, 1914 (99 days of growth). The results, given in the appended table, show that sorrel (usually considered to indicate

a lack of lime in the soil) can grow well in a strongly alkaline soil. The photographs which accompany the paper show that the roots developed vigorously even in the presence of considerable quantities of limestone and dolomite.

Weight in grams of whole air-dried sorrel plants, grown in pots containing varying percentages of limestone and dolomite.

	Pot number									
	1	2	3	4	5	6	7	8	9	10
Sand + limestone	1.61	0.42	1.06	1.91	0.75	1.83	1.48	1.24	0.51	1.82
Sand + dolomite	3.34	6.54	1.20	1.51	1.38	1.02	1.57	3.96	3.87	1.66

387 - Movement of Soluble Salts Through Soils (1). — Mc COOL, M. M. (Professor of Soils) and WHEETING, L. C. (Instructor in Soils, Michigan Agricultural Experiment Station), in the *Journal of Agricultural Research*, Vol. XI, No. 11, pp. 531-547, 16 Tables, 3 Figs. Washington, December, 1917.

The principal work on this subject is first reviewed :—

1) MUNTZ and GAUDECHON concluded that, in rather dry soils, certain fertilizer salts take up water from the surrounding soil and remain for a long time localized in the moist area ; in somewhat moist soils this movement does not take place, and, even in moist soils, the diffusion of the salts is very slow on account of the discontinuity of the soil mass.

2) MALPEAUX and LEFORT, who studied the movement of nitrates in sandy and loam soil respectively showed that, both horizontally and vertically, the salts diffuse very slowly.

3) DEMOLON and BROUET showed that salts have a general tendency to remain at the surface of the soil and that rather large amounts of rain are required to carry nitrates into the subsoil.

The authors then describe the new experiments they carried out to control the results hitherto obtained ; one series was made with fine textured soils, and a second with coarse textured soils. Their principal results may be summarised as follows :—

1) In moist soils the soluble salts move from regions of high to those of lower concentration. The movement is rather rapid and the salts do not remain long localized as has been stated by previous workers. Moreover, the water content of the soil and the amount of salt present influence the rate of movement.

2) Where moisture is lost by evaporation the upward movement is more rapid than the downward movement in heavy soils ; in coarser soils such as sand, the downward movement is slight. This explains why, during drought, the soluble salts are more exposed to loss by upward movement in sandy soils than in heavier soils.

3) Chemical analyses show that, as the salts move through the soil

(1) See also R. 1916, No. 615. (Ed.)

the solution in the various layers of soil changes in composition. These changes vary according to the physical nature of the soil. Thus, the addition of 1 % of sodium chloride caused, in the soil solution of sandy soil, a gradual increase in the calcium and magnesium content in the layers above that to which the chloride was added. In silt loam, however, the maximum magnesium and calcium content were in the second layer, and dropped sharply in the third and fourth layers. These changes in composition should have an important influence on the effects produced by the use of fertilizer salts.

4) The movement of soluble salts in the soils is brought about by diffusion as a result of the chemical reaction in the soil and by the movement of the water (1).

358 - **Total Nitrogen and Carbon (2) in Cultivated Land and Land Abandoned to Grass and Weeds.** — BLAIR, A. W. and MCLEAN, H. G. (New Jersey Agricultural Experiment Station), in *Soil Science*, Vol. IV, No. 4, pp. 283-293, 1 Fig., bibliography of 18 publications. Baltimore, October, 1917.

The work already done on this subject proves beyond doubt that the nitrogen and organic matter of cultivated land are rapidly exhausted in spite of the addition of fertilisers and green manures. In uncultivated land, however, the loss is less, and, in some cases, there are pronounced gains. Although the loss of nitrogen in cultivated land is partly due to the crops, which absorb a certain quantity of it, and to drainage waters in which it occurs as nitrates, the information available is not very definite.

In 1913 and 1916 the authors determined the nitrogen content of a sandy-loam soil allowed to run wild from 1908 to 1916, receiving annually during that period 600 lbs. of dried fish manure per acre. The nitrogen content remained fairly constant, but the carbon content increased slightly from 1913 to 1916.

On the other hand, the average nitrogen content of adjoining crops under a five year rotation (maize, oats, wheat, two years of grass) was 0.02 % less in 1913 and 0.023 % less in 1916 than that of the corresponding uncultivated plots, and the carbon content 0.27 % less in 1913 and 0.30 % less in 1916.

Two cultivated plots which received no nitrogen and were used as controls, gave an average total of 196.13 lbs. of nitrogen in their crops during the nine years. From six plots treated with nitrogenous manure during the same period, an average of 329.94 lbs of the organic nitrogen applied was recovered.

It is thus clear that the percentage of nitrogen and carbon in cultivated soils decreases even when 600 lbs. per acre of dried fish manure are applied annually, whereas the percentage of nitrogen in uncultivated soils which have received the same organic nitrogenous fertiliser remains about constant. The experiments show that, in cultivated soils, nitrogen is the limiting factor, and the fact that nearly $\frac{2}{3}$ of the nitrogen of organic nitro-

(1) Other work in the United States on the concentration of nitrates in the soil confirm these conclusions. See *R.* Feb., 1918, No. 129. — (2) See *R.*, Jan., 1918, No. 8. (Ed.)

genous fertilisers is unaccounted for is not in favour of the use of commercial nitrogenous fertilisers of an organic nature if those of mineral origin are available.

389 - **The Effect of Different Salts on Ammonia Formation in Soil.** — KOCH, G. P. (New Jersey Agricultural College Experiment Station, New Brunswick), in *The Journal of Biological Chemistry*, Vol. XXXI, No. 2, pp. 411-413, bibliography of 5 publications, Baltimore, August, 1917.

It has been shown by TOTTINGHAM and SHIVE, using plants in nutrient solutions of controlled concentrations, that high concentrations of salts are injurious to plants, while the same combination of salts at lower concentrations does not retard their growth. Similarly, the writer, controlling the concentration of the solution, studied the effects of a 3-salt solution (the physiological balance in nutrient solution) upon the decomposition of dialysed peptone by a pure culture of bacteria and found the same effects. So, in order to avoid osmotic differences all solutions used in the work were made up to an osmotic pressure of 2 atmospheres.

Different combinations of magnesium sulphate, potassium sulphate and monocalcium phosphate were applied to 100 gm. of soil mixed with 155 m gm. of nitrogen (dried blood). The mixture was incubated for 8 days and the ammonia distilled off by the usual method.

The following results were obtained:

1) In combinations of the salts where monocalcium phosphate was present in only 0.1 of the total concentration, a considerable increase in ammonia formation was apparent.

2) When 0.8, 0.9, or all of the total concentration was supplied by monocalcium phosphate, the ammonia formation was approximately 26.0% greater than when no salts were added to the soil.

3) Magnesium sulphate and potassium sulphate singly or in combination were toxic where no monocalcium phosphate was added to the combination.

390 - **Aluminium as a Factor Influencing the Effect of Acid Soils on Different Crops** — HARTWELL, BURT L. and PEMBER, F. R., in the *Journal of the American Society of Agronomy*, Vol. X, No. 1, pp. 45-47, Lancaster, Pa., January 20, 1918.

Many workers have called attention to the injurious effects of the hydrolysis of aluminium salts, caused by the liberation of free acids, measured by an increase in the hydrogen-ion concentration. Hitherto these effects have been attributed to the increase in acidity only, and not to the aluminium.

For a number of years the Rhode Island Agricultural Station has attempted to ascertain why different varieties of plants vary so remarkably in their response to liming. For example, under the same conditions, liming may double or triple the yield of barley and have no effect whatever on rye. Nevertheless, the authors found that the addition of acid to ordinary nutrient solutions had as depressing an effect on rye as on barley seedlings. This shows that the toxicity of so-called acid soils is not due to the acid alone, as, if it were so, the effects on the two seedlings would be similar.

The aqueous extract of an acid soil, like the soil itself, affected the two kinds of seedlings very differently, thus showing it to contain a substance which was not present in the ordinary nutrient solution. Sterilisation, dialysis, partial distillation, etc., indicated that this substance was crystalloid. By evaporating the extract, igniting and dissolving the residue in acid, a culture medium was obtained which was much more toxic to barley than to rye. Besides the ordinary nutrients the residue was found to contain silicon, aluminium and chromium. Aluminium being present in large quantities a study was made of the effects of this element by itself, or in combination with silicon, chromium, and other substances. The results led the authors to doubt the hypothesis that acidity is the only, or the main, factor influencing the growth of plants in acid soils.

When an amount of aluminium sulphate equivalent to that found in the soil extract was added to the culture medium, the barley seedlings suffered much more than the rye, but when the same amount of sulphuric acid without aluminium was added the rye suffered as much as the barley. The hydrolysis of the aluminium sulphate gave a hydrogen-ion concentration equal to $\frac{1}{4}$ only of that obtained with the equivalent amount of free acid. The aluminium sulphate must thus have been the principal cause of the depression in the growth of the barley, and have had a much smaller effect on rye. In other words, the nutrient solution containing the aluminium had the same effect as the aqueous extract of an acid soil.

If aluminium is an important factor in the injurious effects of acid soils, any treatment which renders it less active will prove beneficial. A moist acid soil, upon which most plants died, was thoroughly mixed with the extraordinary amount of 28 tons per acre of acid phosphate, and after two weeks lettuce was planted. This crop could not exist in the untreated soil supplied only with nutrients, but in the soil treated with acid phosphate it gave a maximum crop, exceeding even that obtained when lime was used instead of phosphate.

It was shown that, for a considerable time, the large amount of acid phosphate greatly increased the acidity, yet a crop which usually responds well to liming made its maximum growth on a very acid soil without the addition of lime. The solubility of the aluminium in dilute acetic and carbonic acids had been markedly reduced by the phosphate, as it undoubtedly could have been by lime or lime and phosphate.

The determination of the "active" aluminium may, therefore, prove as useful as the determination of the acidity, and the lime requirements of a soil may be due to the need of lime to precipitate the toxic aluminium just as much as to the need of lime to neutralise its acidity. Indeed, it was found that after sufficient hydrated lime had been added to produce a maximum crop of lettuce, the soil still had, at the end of the vegetation experiment, a lime requirement equivalent to 4 000 to 5 000 lbs. of calcium oxide per acre, in spite of the fact that nearly all the lime had reacted with the soil.

391 — **Nitrates and Nitrification in Relation to Cultural Practices and Plant Growth.** — NOYES, H. A. (Scientific Proceedings of the Society of American Bacteriologists), in *Abstracts of Bacteriology*, Vol. 1, No. 1, pp. 38-39. Baltimore-London, February, 1917.

Soil bacteriological studies were carried out in an experimental orchard cultivated in different ways — clean culture with cover crop; unploughed, with grass cut and heaped round the trees; unploughed with grass cut and left where it falls. The aims of the experiments were:—*a*) to determine if the behaviour of the trees can be correlated with the activities of the bacteria in the soil; *b*) to determine the effect of this activity on the soil itself.

The results are summarised in the appended table; one season was dry, the other wet.

Yearly nitrates, nitrification and tree growth (averages of 2 years).

Data	Unploughed with straw mulch	Clean culture with cover crop	Unploughed		
			Grass cut and piled		Grass cut and left where it falls
			Hillside	Upland	
Circumference gain of trees (cm)	5.67	5.10	4.47	4.34	3.33
Nitrates in field (per million)	155	432	54	50	49
Nitrates after 6 weeks' incubation (per million)	1624	1443	2756	1484	1511
Nitrification (per million)	1519	1011	2202	1433	1462
Field nitrification (%)	17.5	33.5	9	6.5	8

From the results it is seen that:—

- 1) The nitrates in the field correlate with tree-growth (circumference gains);
 - 2) A lower field nitrate content does not imply lower nitrate content after incubation;
 - 3) The field nitrates, when compared with the nitrates after incubation, give the nitrifying efficiency of the organism under field conditions.
- Knowledge of the nitrate content of field soil may throw more light on the activities of nitrifying bacteria than the nitrification test itself.

MANURES
AND MANURING

392 — **Nitrification as a Measure of the Availability of Different Forms of Calcium Carbonate when Employed as Correctors of Soil Acidity.** — BURGESS, P. S. (Hawaiiian Sugar Planter's Experiment Station, Honolulu, T. H.), in *Soil Science*, Vol. IV, No. 4 pp. 327-336, bibliography of 3 publications. Baltimore, October, 1917.

Finely ground coral limestone and coral sand were examined for their use as fertilisers; both are identical chemically and only differ in their physical characters. They were applied to acid Hawaiian soils in quantities sufficient to neutralise the acidity. The mixtures were incubated for 20 weeks and the nitric nitrogen content determined every two weeks. For purpose of comparison similar quantities of the mixture were incubated with the addition of dried blood or ammonium sulphate.

Similar results were obtained with the two lime fertilisers only when no other addition of nitrogen to the soil was made. When another fertiliser

was added, the finely ground coral limestone was $1\frac{1}{2}$ times as efficacious as the best coral sand. Where no lime is added to the soil, nitrification is more abundant in the presence of dried blood than ammonium sulphate; but where lime of any description is added the reverse is true.

393 - **Changes Occurring During the Storage of Manure.** — RUSSELL, E. J. and RICHARDS, E. H. (Rothamsted Experimental Station), in *The Journal of Agricultural Science*, Vol. VIII, Pt. 4, pp. 494-503, 10 Figs. London, December, 1917.

After having discussed the previous work on the subject, the authors describe a series of investigations, carried out in the laboratory and on farms, which aimed at determining the changes produced in the manure heap, independently of the behaviour of the manure in the soil. To this end a study was made of the variations in the content in dry matter and combined nitrogen which occur during the storage of manure under varying conditions.

There is a great loss of free nitrogen, caused by the continual change from aerobic to anaerobic conditions in the heap and vice versa. The authors suggest that this loss is due to the fact that under anaerobic conditions there is a tendency towards the formation of molecular groups; these groups become unstable as soon as aerobic conditions are produced, or the converse occurs. It is known that, in contact with air, certain carbon compounds formed under anaerobic conditions may change into less complex compounds with elimination of the bivalent methyl groups ($-\text{CH}_2-$). By analogy, therefore, certain complex nitrogen compounds may possibly change into more simple compounds, with liberation of nitrogen. The alternating nitrification and denitrification in the manure heap only represents a special case of this general phenomenon.

For this reason stored manure should be kept under as complete anaerobic conditions as possible, preferably at a temperature of 26°C . Experiments are being made to apply these conditions practically. However this may be, it appears certain that the custom of leaving the manure under the cattle in the stables or under open sheds, until required for use, is the best, wherever possible. No manure heap, however compact and well covered it may be, can fulfill the above conditions; perhaps they might be obtained by keeping the manure in water-tight and perfectly closed tanks at the given temperature. It seems improbable that ordinary manure heaps can be further improved.

394 - **The Problem of Potassium Salts in Italy.** — I. LEVI, M. G. Per l'industria dei sali potassici e del bromo. *Ministero per l'Industria, il Commercio e il Lavoro, Atti del Comitato per le Industrie Chimiche*, pp. 51-60. Rome, 1917. — II. MANZELLA, R. Le acque madri delle saline marittime e il problema dei sali potassici in Italia, *Annali di Chimica applicata*, Vol. VII, Nos., 1-2, 3-4, 5-6, and 7-8; pp. 1-27, 123-144. Rome, 1917. — III. LEVI, M. G. Per l'industria dei sali potassici e del bromo. *Relazione suppletiva. Ministero per l'Industria, il Commercio e il Lavoro, Atti del Comitato per le Industrie Chimiche*, pp. 61-63. Rome, 1917.

I. — The problem of potassium salts in Italy is above all an agricultural one, though many special chemical industries are also interested in it. Besides the German sources, there are others which in the future, may be-

come important, those of Kalucz in Galicia, Catalonia, Ethiopia, and doubtless others, but, as far as possible, the Italian agricultural problem should be solved independently of foreign mineral resources.

Good progress has already been made in Italy in the use of the carbon residue of sugar molasses, which, treated in large quantities, would without doubt yield an appreciable amount of salts. It has been proposed to use similar residues obtained by the evaporation and ignition of the lees of olive oil, but there appears to be some difficulty in the collection and transport of these products, of which there is a considerable quantity, spread over many different and large districts. The ash of plants is well used already, especially in soap factories. The investigations and experiments on the extraction of potassium salts from rock have not yet given quite satisfactory results (1). The sea may yet be used as a source not only of potassium salts, but also of bromine, sodium sulphate and magnesium salts, and in Italy, as for some time past in France, it has been considered as a source of potassium salts. This method would solve two problems at one time — the supply of agricultural potash and industrial bromine.

Italy is eminently a country of salt production. The amount of marine salt obtained annually exceeds 500 000 metric tons, and to this must be added rock salt and that obtained from salt springs. For many years the problem of the extraction of potassium salt from mother-lye of salt spring has been studied. Moreover, according to the communications of the General Office of State Monopolies of the Ministry of Industry, the investigations and experiments carried out since 1915 on the extraction of potassium salts for agricultural purposes from the mother-lye of salt springs has given fairly satisfactory results, and the Italian Office of Finance proposed to start the industrial production of these salts on a large scale from 1916. Work to this purpose is now being carried out at the salt springs of Sardinia from which a large quantity of suitable lye may be obtained.

II. — With regard to Sicily, information is given on the salt spring of Trapani, together with remarks on this product and the more rational use of the mother-lye, the greater part of which is re-circulated to improve the salt deposit of the concentrated "first waters". The volume of mother-lye available at 32.4° Beaumé per metric ton of salt would be 307.258 cubic feet in Sicilian salt springs. Applying this yield to the average salt production of the whole of Sicily a total of 3 789 130 cubic feet is obtained.

Taking this yield as a basis, it may be estimated that, in the other Italian salt springs, the volume of mother-lye available per ton of salt produced would be about 42.38 cubic feet, corresponding to a total of 11 975 000 cubic feet.

Analyses of the mother-lyes of salt springs are given, and, after quoting the results obtained by BAIRD, USIGLIO, POHL, MERLE, CERUTI, ASQUI and LACROIX, who, in water at 30° Beaumé per litre, found a potassium

(1) Though the possibility of leucite production in Italy is unlimited, the present yield is about 1 000 metric tons per annum. (Ed.)

content of 9.06, 18.73, 19.06, 7.69, 23.07, 22.51, 31.28 grams respectively, the author gives the results of an analysis he made of a sample of mother-lye at 31.4° Beaumé, taken from the salt springs of Ronciglio at Trapani. The results are as follows:—

Cations	gm. per litre
Sodium	44.714
Potassium	15.583
Calcium: small quantity not estimated	—
Magnesium	57.978
	118.277
Anions	
Chlorine	100.858
Bromine	2.383
Sulphuric	82.480
	275.720
Total: grams per litre	394.006

If the various components were brought to their probable salt combinations the composition of the residue would be:

Sodium bromide	gm.	3.067 per litre
Sodium chloride	"	111.910 " "
Potassium chloride	"	29.719 " "
Magnesium chloride	"	146.168 " "
Excess of SO ₄ considered to be combined with the calcium	"	1.282 " "
Total	gm.	394.383 per litre

Calculating the mother-lye at 30° Beaumé, the potassium chloride content would be 25.55 gm. per litre, and from the available mother-lyes of the Italian salt springs it would be possible to extract annually 258 398 cwt. of KCl and 21 205 cwt. of bromine. The 32 salt springs of Trapani which, for various reasons, are best suited for such extraction, would yield 48 427 cwt. of potassium chloride and 3 881 cwt. of bromine.

III. — The potassium deposit of Ethiopia is at Dancalia, nearly 10 miles from the frontier of Italian Eritrea. A little over a year ago a society with a capital of 2 million lire (about £ 80 000) was formed to work this deposit. The salt plain in which the deposit lies, is for the most part, a depression below sea level, and is the bed of an old sea, separated from the Red Sea by volcanic eruptions. The deposit has an area of about 482 square miles. At the surface is found very pure, 90-95 %, potassium chloride. The lower layers are composed of 40 to 80 % chloride. Investigations and calculations show this deposit to have a capacity of about 2 million metric tons of 95 % potassium chloride, 1.40 000 tons of which are on the surface.

Near by there are also deposits of magnesium chloride, and sulphur including about 282 536 to 353 170 cubic feet of the latter. From February to November 1916 this society imported into Italy 2 500 metric tons of 95 % potassium chloride, and, from December, expected to import 1 000 tons monthly. It was certain of being able to supply Italian Agriculture with all the potassium salts required for 1917, and of being able to hold its own against all competition after the war. If this industry really develops as is expected it may cause a great change in the problem of potassium salts for Italy.

In view of a greater development of agriculture in Italy, of the need for bromine which will be felt in the new industries, of the possibility that the Ethiopian potassium chloride deposits will be unable to satisfy the need for potassium salts in Italy, and in view of the fact that changed conditions after the war will allow export trade in these products, the author considers that the extraction of potassium salts and bromine from the mother-lye of Italian salt springs should not be neglected. A careful and detailed financial, technical scheme for the formation in Sicily of works capable of dealing with 3 531 700 cubic feet of mother-lye per annum showed the estimated balance to be :

<i>Cost of Installation</i>	<i>1 000 000 lire</i>
<i>Products obtained annually, not including mixed salts and a possible production of sodium sulphate :</i>	
39 368 cwt. of magnesium sulphate at 5 lire . .	199 000 "
67 894 cwt. of 80 % potassium chloride at 20 lire	700 000 "
3 937 cwt. of bromine at 400 lire	800 000 "
<i>Total</i>	<i>1 600 000 lire</i>
<i>Annual outlay (estimating the mother-lye at 1 lira per 35.31 cubic feet)</i>	<i>900 000 "</i>
<i>Net profit</i>	<i>700 000 lire</i>

Admitting that these figures are estimated with excessive prudence, it is seen that the problem of the method to be adopted for treating the mother-lyes of Italian salt springs is worthy of most serious consideration by the government and manufacturers.

395 - **The Influence of Sodium Nitrate upon Nitrate Transformations in Soils with Special Reference to its Availability and that of other Nitrogenous Manures.**—COLEMAN, DAVID, A., in *Soil Science*, Vol. IV, No. 5, pp. 345-432 + 1 fig., bibliography of 226 publications. Baltimore, November, 1917.

After a full historical and critical review of the question, the author describes his own experiments on the influence of sodium nitrate on the transformations of nitrogen in the soil, by determining its effects upon the ammonification, nitrification, and nitrogen fixation capacity of seven different types of soil (1 very fine sand, 1 loam, 2 sandy loams, 1 clay loam, 1 muck loam, 1 silt loam). The hygroscopic moisture, apparent specific gravity, water-holding capacity, lime requirement, nitrate content and ammonia content of the soils were determined.

It seems certain that the addition of sodium nitrate increases markedly the simplification by hydrolysis of the protein molecules of the soil, for example, cottonseed meal is ammonified to a much greater extent than dried blood. On the other hand, acid phosphate increases the ammonification of dried blood, but potash, in the form of chloride, has little effect.

In alkaline soils sodium nitrate loses its stimulating action to a large extent as regards ammonification; this is due to the increased number of bacteria which assimilate the products of scission by hydrolysis, and to a rearrangement of the soil flora. It is the fungi of the soil which respond the most to applications of sodium nitrate, then the bacteria, the stimulating action of the nitrate being due to an anion.

As regards nitrification, the influence of sodium nitrate is greatest on dried blood, then on cottonseed meal, and, to a lesser degree, an ammonium sulphate, but when present in large quantities it decreases nitrification, and has a similar effect on the nitrogen fixation by *Azotobacter*. In amounts up to 5000 lbs. per acre, sodium nitrate affects the activity of azotobacteria and azotococci in a similar manner, but in larger quantities it inhibits the activity of azotobacteria. The action of sodium nitrate is most detrimental to nitrogen-fixing bacteria, less so to nitrifying bacteria, and still less so to the ammonifying group.

In short, from the point of view of practical agriculture, sodium nitrate usually has a stimulating action on the activity of ammonifying and nitrifying microorganisms, but inhibits that of the nitrogen-fixing group. Nevertheless, if sodium nitrate is applied rationally there will be no danger of a toxic action, and there is reason to believe that the assimilation of soluble mineral fertilisers contributes to the recovery of the nitrogen supplied to the soil.

36 - **Experiments on the Bacterisation of Peat for Soil Fertilising Purposes.** — JONES, D. H. (Scientific Proceedings of the Society of American Bacteriologists), in *Abstracts of Bacteriology*, Vol. 1, No. 1, pp. 43-44. Baltimore-London, February, 1917.

Peat bacterisation experiments were carried out with the object of verifying the claims made by Prof. BOTTOMLEY for "humogen" (1). Five bushel lots of peat were taken; to three was added lime in varying quantities and they were then inoculated with rich broth cultures of soil bacteria; the 4th. lot was inoculated only with the same culture, and the 5th. kept as control. All were incubated at 25° C. for one month, moistened and aerated occasionally. They were then autoclaved for 1 hour, after which rich cultures of *Azotobacter*, *Pseudomonas radicola* and cellulose fermenting bacteria were added to all except the control, and the lots incubated at 25° C. for two months. Chemical tests and bacterial counts were made from time to time.

The different lots of peat thus obtained were mixed in 0.5, 2 and 10 percentages with a poor soil, the mixture placed in pots and radishes sown.

(1) See R. 1917, No. 714. (Ed.)

After 1 month the growth and greenness of the foliage was markedly in favour of the 10 % bacterised peat. After 3 months the results were, as a rule confirmed, both as regards growth of roots and of leaves, in favour of heavy applications of bacterised peat, up to an increase of more than 100 % in plant growth. The following results were obtained : —

Soil containing	Weight of roots	
	Bacterised peat	Unbacterised peat (control)
	gm.	gm.
0.5 % of peat	39.33	35.5
2 % „ „	57.75	41.75
10 % „ „	135.25	63.25

The addition of lime had little, if any, effect.

To sum up, the bacterial treatment of peat seems to make the peat useful as a fertilizer, but the large quantities necessary to produce appreciable results excludes its general use as a fertiliser on account of the expense entailed.

397 — Fertiliser Applied to the Potato in Illinois, U. S. A. — See No. 416 of this *Review*.

398 — Irrigation in the Island of Cyprus. — See No. 376 of this *Review*.

PERMANENT
IMPROVEMENTS:
DRAINAGE AND
IRRIGATION
AGRICULTURAL
BOTANY,
CHEMISTRY
AND
PHYSIOLOGY
OF PLANTS

399 — Studies on Inulin in Plants : I. Its Formation ; II. The Changes it Undergoes in the Resting Tuber of the Jerusalem Artichoke. — COLIN, H., in the *Comptes rendus des Séances de l'Académie des Sciences*, Year CLXVI, I. No. 5, pp. 224-227. February, 1918 and II. No. 7, pp. 305-307. February 18, 1918, Paris.

I. — The formation of inulin in plants is not yet well understood according to some authors, inulin is formed in the leaves, and then migrates unchanged into the roots or tubers ; others think that the inulin-storage organs only receive sugar from the leaves, the sugars afterwards condensing to form inulin.

Chemical examination of several inulin-containing plants, particularly the Jerusalem artichoke, has led the author to believe that there is a question of the immediate elaboration of inulin by the leaves and its migration unchanged to the underground organs. It is osmotic pressure (MAGUENNE's law) that controls the storage of inulin as it does the storage of saccharose ; the leaves only form sugars which are condensed either during their passage down the stem or only in the roots or tubers.

II. — Since 1867, DUBRUNFAUT (1) has recorded that Jerusalem artichoke tubers gathered in March give juice with a positive rotation, while those gathered in October give a decidedly laevorotatory juice ; he attr

(1) DUBRUNFAUT, *Comptes rendus*, Vol. LXIV, 1867, p. 764. (Author)

butes that difference to the transformation of the inulin into crystallisable sugar during the rest period.

In reality, saccharose is always present in tubers undergoing formation, while the proportion is only augmented during the winter months.

DUBRUNFAUT thought that "inulin changed into two isomers, crystallisable cane sugar and an uncrystallisable sugar, optically inactive, and similar to that found in the fermentation of inverted sugar". This conclusion is not entirely justified; in fact, the direct rotation of the juice obtained in February to March is not more than $+10$; correlatively, after inversion the rotation reaches -55 at 15°C ; thus there exist at that period in the tubers, laevorotary principles, giving laevulose on hydrolysis, and which almost completely neutralise the positive rotation of the saccharose. These levulosanes differ greatly from the primitive inulin; their total rotatory power, ranging from -25 and -30 , is less than that of inulin (-40 according to TAUBERT); but they can be hydrolysed by invertine and ferment, in consequence, in the presence of yeast. If sucrose is added to the juice of the Jerusalem artichoke, the reducers increase progressively while, at the same time, the power of rotation decreases; the saccharose is hydrolysed more rapidly than the levulosanes. All the carbohydrates are hydrolysed. When the juice is left standing in presence of an antiseptic, they transform spontaneously, but much more slowly.

These facts show why, in the distilling industry, Jerusalem artichoke tubers treated in October require a previous hydrolysis by acids, whilst those of tubers collected after winter may be fermented at once.

One part of the inulin changes, therefore, to saccharose in the tuber; the other part is degraded progressively to form levulosanes with an optical rotation lower, in absolute value, to that of inulin.

These phenomena are not limited to the Jerusalem artichoke; they also occur in chicory, in which they were observed by MM. WOLFF and GESLIN (1).

420 - **Studies on the Cyanogenetic Compounds of Sorghum.** — WILLAMAN J. J.: I. The Estimation of Hydrocyanic Acid and the Probable Form in which it Occurs in *Sorghum vulgare*; II. The Effect of Anaesthetics and of Freezing on the Cyanogenetic Compounds of *Sorghum vulgare*. *The Journal of Biological Chemistry*, Vol. XXIX, No. 1, pp. 25-26, pp. 37-45. Baltimore, February, 1917.

I. — The methods generally in use for the estimation of cyanogenetic compounds in vegetable tissues (based on the hydrolysis of the cyanogenetic glucoside and the amount of hydrocyanic acid thus formed) are of doubtful accuracy, partly on account of the difficulty of obtaining complete hydrolysis with acids, partly on account of the partial retention by the tissues of the hydrocyanic acid during distillation, which is neither prevented by the addition of tartaric acid, nor diminished by distillation under reduced pressure.

Sorghum vulgare contains hydrocyanic acid in two forms: — a glucoside (dhurrin) and a non-glucosidic cyanide compound, the nature of which is

(1) See *R.*, Dec. 1917, No. 1137 (*Ed.*).

as yet unknown. It is probably the latter which causes poisoning of live-stock. The best method of obtaining hydrolysis of the dhurrin is by autolysis, which occurs very rapidly at 45° C. The non-glucosidic cyanide may be separated from the glucoside by grinding the leaves in the presence of 5 % tartaric acid to prevent enzyme action and then distilling. By these means only the hydrocyanic acid from the non-glucoside substances is obtained; the latter are more unstable and decompose when boiled with a 5 % tartaric acid solution.

II. — Sorghum leaves exposed to the action of chloroform, ether, and alcohol, yield more hydrocyanic acid, both glucosidic and non-glucosidic, than normal leaves. The anaesthetics thus stimulate the hydrolytic as well as the synthetic action of the glucoside enzymes (this is a case of synthesis caused by enzymes *in vitro*). Enzyme powder prepared from chloroformed leaves was about 25 times as active towards amygdalin as the powder from untreated leaves. An examination of leaves which had been exposed to frost in the field and of leaves which had been subjected to a temperature of 7°C. showed that frost causes an increased yield of both glucosidic and non-glucosidic hydrocyanic acid. This is due partly to rupturing of the cells, and partly to disturbed enzyme equilibrium.

401 — Analysis of *Zamia Palm Nuts and Leaves*. — *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 12, p. 865, Sydney, December, 1917.

An analysis made at the Chemist's Branch of the Department of Agriculture of New South Wales gave the following results :

	Kernel	Leaves
Moisture	81.79 %	76.67 %
Ash	1.07	0.99
Ether extract	0.18	0.21
Fibre	4.74	6.18
Albuminoids	0.03	2.64
Carbohydrates	12.19	13.31

402 — The Chemical Composition of the Potato Plant at Various Stages of Growth. — See No. 475 of this Review.

403 — The Growth of Isolated Plant Embryos. — BUCKNER, G. DAVIS and KASTLE, JOSEPH H. (Laboratory of Chemical Research, Kentucky Agricultural Experiment Station, Lexington), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 2, pp. 209-213. Baltimore, Md., March, 1917.

In their experiments the authors attempted to nourish embryos of Lima beans (*Phaseolus lunatus*), deprived of the cotyledons, with different compounds. Sugars (2% solutions of glucose, saccharose, lactose, raffinose, mannite and maltose) caused growth, but starch or Hopkins' plant food had no influence. It has been shown that cotyledons which give no characteristic reaction for reducing sugars cause no growth, whereas the same cotyledons, when supplied with sugar, give a good growth. It was further

shown that the cotyledons of lima beans that have germinated and contain reducing sugars may also support the growth of an isolated embryo.

The results seem to show that growth of the embryo occurs wherever inucose or a carbohydrate giving a hexose on hydrolysis is present. When these substances are absent no growth results. It was further shown that the dry Lima bean does not contain the plant food necessary for the growth of its own embryo, but that the green cotyledons of a germinated bean do contain the food necessary for the normal growth of the plant.

91 - **Variations in the Development of Secondary Rootlets in Cereals.** — WALWORTH, E. H. and SMITH, L. H., in the *Journal of the American Society of Agronomy*, Vol. X, No. 1, pp. 32-35, Lancaster, Pa., January 20, 1918.

The method adopted was to sow 100 or more grains from each variety studied in pots containing pure quartz sand, which were kept in a greenhouse. The secondary rootlets were counted when the plumule was from 2 to 2 inches high. The results, which confirmed those of Mr. R. G. WIGGANS (*Journal of the American Society of Agronomy*, Vol. 8, No. 1, pp. 31-37, 1916), showed that the number of secondary rootlets is by no means constant for a given variety, but varies with the individual, so that counts made from samples chosen at random usually give a frequency distribution represented by a fairly normal curve.

In oats the number of secondary rootlets varies from 0 to 5; each variety has a tendency to a high or low number of secondary rootlets, the number of frequency being 2 for some and 3 for others.

Of 11 varieties of wheat examined, 9 had a number of frequency equal to 2; in the two others it was equal to 4.

In barley the maximum number is 7, the number of frequency being 1 in some varieties and 4 in others.

The number of secondary rootlets is also variable in maize.

The range of variability is less in pure-line selections of oats than in the ordinary varieties. This is also true for wheat, with the exception of Turkey hybrid No. 509, which was more variable than the other selected varieties, perhaps because of its hybrid origin.

95 - **The Selection and Hybridisation of Cereals in Alaska, U. S. A.** — GEORGESON, C. C. *Annual Report of the Alaska Agricultural Experiment Stations 1903-1915*. Washington, 1905-1916.

PLANT
BREEDING

The introduction of the cultivation of cereals in the districts bordering the arctic polar circle is of both practical and scientific importance.

In Alaska there is a great difference between the climate of the coast and that of the interior of the country. Along the Pacific, to the south of the high chains of the Alaska Range and of the St. Elias and Coast Ranges, the summer is cool, but the winter mild, so that at Sitka, for example, the average annual temperature is almost the same as that of Washington, D. C. In this district, the cool summers, abundant rainfall, and frequent clouds, are favourable to the growth of vegetables and grasses but unfavourable to that of ordinary crops, especially cereals, which do not ripen in the interior, however, along the Yukon valley, between the coast Sierra

and the mountain groups of the southern sector (Endicott Range), the climate is decidedly continental, with dry, very cold winters and short summers, but nevertheless capable of causing rapid plant growth owing to the large number of hours of sun daily (18 to 20).

AGRICULTURAL STATIONS. — Alaska possesses 6: —

1) *Sitka*, on the western coast of Baranof Island, a little above the 57th. parallel; fruit trees and bushes are studied there.

2) *Kodiak*, on the eastern coast of Kodiak Island, near the 58th. parallel, concerned with animal husbandry.

3) *Kenai*, on Cook Inlet, near the 61st. parallel; marsh plants, fodder plants and animal husbandry.

4) *Copper Center*, in the valley of the Copper River, about 100 miles from the coast. This Station, which dealt with cereals and marsh plants, was closed in 1909, and all the material received was transferred to *Fairbanks* and *Sitka*.

These four districts have a coastal climate, with mild winter but cool, rainy summers.

5) *Fairbanks*, in the Tanana Valley, a tributary of the right bank of the Yukon, near the 65th. parallel; it deals with cereals, fodder plants, hood crops, the breeding of resistant livestock for the interior.

6) *Rampart*, on the Yukon River, near the 66th. parallel; it is the most northern station and is concerned with cereals and forage Leguminosae.

The two localities are in the district having a continental climate.

INTRODUCTION, ACCLIMATISATION AND IMPROVEMENT OF CEREALS IN ALASKA. — The work is organised as follows: —

1) *Acclimatisation experiments* of the greatest possible number of varieties from districts differing greatly from each other, situated especially in northern countries where the conditions for cereal growing are similar to those found in Alaska.

2) *Selection*: after the varieties capable of developing normally in the country have been determined, each is selected individually with a view to isolating lines having the most desirable characters, chief of which is earliness.

3) *Hybridisation*: in the successive individual selection, earliness is often accompanied by low yield, weak culms, etc. Attempts are made to obviate these faults by crossing early types with those which yield well and have strong straw, etc., so as to unite in one type the positive characters and eliminate the negative ones.

The work on cereals was first started at Kenai, Sitka, Copper Center, Fairbanks and Rampart, and then limited to the two last because at Sitka and Kenai, the wetness and low temperatures of summer prolong the period of growth to such an extent that the crops are exposed to the first, destructive, autumn frosts when, even under the most favourable circumstances, they have barely reached the milk-ripe stage. As has already been said, the Copper Center Station was closed in 1909. Varieties of barley and

plants have been tested at Sitka, rye and winter wheat at Kenai. The varieties tested were: —

- 1) *Barley*: — Erhard Frederiksen; Naked Barley S. P. I. (t. c. Section Plants Imported, S. Dept of Agric.) No. 29 909; Domes Barley S. P. I. No. 29 608; G. I. 593 (from Norway).
- 2) *Oats*: — Erhard Frederiksen.
- 3) *Rye*: — Excelsior; Schlansted Techt Un.
- 4) *Winter wheat*: — Winter wheat; Yaroslav.

At the Copper Center Station, a little more inland, more satisfactory results were obtained than at Sitka and Kenai, and perhaps some varieties, especially of barley, could be grown successfully in the more sheltered parts of the Copper Valley. In any case precautions must be taken against summer frosts, which may destroy the crops completely, as occurred in 1908.

In the Yukon Valley the conditions peculiar to the northern climate oblige the selector to subordinate yield to earliness, so as to allow the varieties selected to complete their growth (from sowing to the ripening of the seeds) in the short interval of 70 to 90 days between the last spring frost and the first, destructive autumn frost. The results obtained for the different varieties of cereals were: —

1) *Winter wheat*. — Numerous varieties were introduced from the extreme northern countries — North Russia and Siberia, as well as the highest plains of the Himalayas. Mention may be made of the varieties Landomirka, Beloglina, Klondike (Canada), Pullman Hybrid No. 28, Wisconsin Pedigree No. 22, Bluestem, Pullman Hybrid No. 143, Pullman Winter Pile, Pullman Fortyfold. In the Upper Yukon Valley three climatic factors are very injurious to winter wheat: —

- a) the winter cold which kills the young plants;
- b) the alternate freezing and thawing in spring which heaves the plants;
- c) the early autumn colds which prevent ripening; the first destructive frost usually occurs towards the end of August.

Kharkov gave the best results of all the varieties tested. It is a slightly bearded wheat and a native of Russia introduced by the Federal Department of Agriculture. It ears in July and at least a part of the harvest always ripens completely by the beginning of September. In spite of its resistance to cold a large percentage of the young plants always die during the winter; for example, in 1913-1914, only 5% of the young plants survived the winter. Winter cereals should be sown where the snow is thickest and lasts longest, so that it may protect the young plants, first against low temperatures, then against alternate freezing and thawing. In spite of nine years' selection the resistance to cold of the Kharkov variety has in no way increased, and, if the hybridisation experiments now in progress give equally negative results, winter wheat in Alaska will be superseded by rye, which is much more resistant to cold.

2) *Winter rye*. — Rye gave much better results than wheat. Whereas, in 1913-1914, 95% of the young plants of Kharkov wheat were killed, the losses in the different varieties of rye varied from 10 to 25%. The best of the many varieties studied were Excelsior, Amber, Giant

French, Brandon, Monster, No. 281, No. 1 134, No. 12 890, North Dakota No. 959, Station No. 195, and Irkoutsk, all fairly equal as regards resistance to cold but differing largely in earliness. In 1914 the date of ripening were:—

Irkoutsk, Giant French, Amber, No. 959, Monster,	
Station No. 195	August 12
Brandon	" 14
No. 1131, No. 12 890, No. 281	" 21

As regards *yield*, mention may be made of that given in 1914 at Fall banks by the variety Winter Rye No. 19 556, which, on a $\frac{1}{8}$ acre plot gave a yield of 1 520 lbs. per acre.

In Alaska the vegetative period of rye exceeds 13 months (1); it sown towards the end of July and harvested at the beginning of September of the following year. It is, therefore, necessary to obtain varieties which ripen earlier so that the grain produced during the year may be used for sowing. The following hybrids are being tested:—Station No. 195 \times North Dakota No. 959; Giant French \times Amber; North Dakota No. 959 \times Giant French.

3) *Spring wheat*.—On the whole the results obtained with spring wheats are not very satisfactory. As sowing is not possible before May, there remain barely 90 days for ripening before the autumn frosts, so that the indispensable character required is earliness. None of the varieties studied ripen for certain each year, but the best were Chogot and Irkoutsk, the vegetative period of which lasted only 88 days (May 1st to August 27th in 1914). These two wheats, introduced by the Federal Department of Agriculture, come from the Agricultural Station of Tulun (Government Irkoutsk, Siberia). The Russian bearded wheat No. 306 is almost as early as these two, and the Russian wheat H. G., of vigorous growth, ripens 10 days later. Then come Ulka, Velvet Chaff, Ladoga, Red Fife, Romano Marquis, Early Java, which usually only ripen once in five years, as was the case in 1912 at Rampart, where the varieties Red Fife, Romanov and Willy Goose gave from 55 to 60 bushels of grain per acre.

The following crossings were made:—

a) Red Fife \times Saskatchewan; b) Chogot \times Saskatchewan; c) Chogot \times Velvet Chaff; d) Chogot \times Irkoutsk; the 1914 hybrids were no earlier than the parent plants, but the ears were larger and more compact, each spikelet containing 5 or 6 grains; e) Red Fife \times Ladoga. Two yet unstable hybrids were obtained which still continue to split up into bearded and unbearded individuals, but they are earlier than the parent plants, thus fulfilling the aim in view.

4) *Spring rye*.—At Rampart, on May 1, 1915, were sown the three varieties Irkoutsk (from Tulun, Siberia), Gesselberg (from Tulun), and Mammoth. The first ripened on August 19, Gesselberg almost immediately after, and Mammoth ten days later. All the spring ryes were inferior

(1) The abstract No. 635 of R. 1916 describes a variety of rye of the Upper Volga of the Dora Riparia (Italy) which remains in the ground for a period which may extend 13 months. (Ed.)

the winter ryes in both earliness and yield. Attempts were made to improve them by selection and hybridisation. The cross Irkoutsk \times Mammoth gave, in the F_1 , hybrids with well-filled heads and the earliness of Irkoutsk.

5) *Oats*. — Experiments have been made with many varieties of oats from northern districts, especially from Scandinavia, Finland, Russia and Siberia. The varieties which appeared most suitable were subjected to continuous individual selection with the purpose of developing the character "earliness". The best results were obtained with the varieties Finnish Black, Norwegian, South Dakota No. 637, Canadian 444 (from California), and Sixty Day, which ripen, on an average in 90 to 92 days, in time to avoid the first destructive frosts. Good results were also obtained with Copperfield, New Swedish, Hansen, Black Tartarian, and Banner, although they are a little late. The varieties Minnesota No. 261, Orlov, Ontario, Ruakura, Russian No. 409, and Beliak (from Yakoutsck, Siberia), have little chance of succeeding in Alaska.

Very little data on yield in grain is available. At Fairbanks in 1912, the varieties Sixty Day, Finnish Black, and Banner yielded 85, 90 and 100 bushels per acre respectively, whereas at Rampart, the yields were not quite half these amounts. It should be noted that all these figures refer to small, chosen plots, with the most favourable exposure possible.

Although the results obtained by individual selection and acclimation with the varieties Finnish Black, Copperfield and South Dakota, leave very little margin for subsequent improvement, hybridisation experiments were carried out some of which gave absolutely positive results. Thus, for example, the hybrids 25 A-1 and 25 A-3, which ripen one day earlier than Finnish Black oats, give as many as 120 grains per head, and, in three years only, are sufficiently stable. Both are derived from the cross Copperfield \times Toholampi. Copperfield is a grey mutation from the Finnish Black variety, from which Toholampi is also derived by selection in pure lines.

6) *Barley*. — Owing to the relative shortness of its period of growth, barley is undoubtedly the cereal most suited to Alaska. Its yields in grain and straw are fairly high, and the nourishing grain, besides being an excellent food for cattle may also be used for making bread. The acclimation experiments have given a large percentage of varieties capable of ripening completely. The best results were obtained with: —

Pamir S. P. I. No. 18922, a bearded barley, native of Central Asia, where it does well at altitudes of from 9800 to 13100 feet, is one of the earliest varieties of barley of the world; at Rampart it ripens, on an average, 76 days after being sown, but yields little.

Champion, a beardless barley of very vigorous growth.

Manchury, also excellent, early productive, with strong straw, but long, stiff, sharp awns.

Chittyna, a beardless barley, productive and with strong straw, but too late; it was isolated in 1906 at Coldfoot, Alaska.

More or less satisfactory results were obtained with:

Beardless No. 19852; *Hull-less* No. 19851; *Urjala* and *Finland* (both natives of Dickursby, Finland); *Swedish* No. 19357; *Jakoutsck* G. I. 498 (native of Siberia); a Russian variety, S. P. I. No. 2786, which, together with a few others, resisted the terrible frost of July 21, 1908,

All the barleys studied were from northern countries, with the exception of Barbary G. I. No. 659, a native of North Africa which in 1911, at Rampart, ripened only one week later than the Pamir variety.

The hybridisation of barley, both in its scope and the results obtained, is much more important than that of other cereals. The three characters essential to a thoroughly satisfactory barley in Alaska are: —

- a) *Earliness*, for the usual reasons already mentioned;
- b) *Absence of awns*, as their presence prevents the feeding of barley in the ear to cattle;
- c) *Strong straw*, to resist lodging.

The best of the numerous hybrids obtained are: —

Hull-less S. P. I. 12 709 \times *Swedish* S. P. I. 19 557. The second used as male parent, was chosen because of its earliness, but it has awns. *Hull-less* is a good variety in every way, but is late. The hybrids have slightly pointed glumes, and may be said to be beardless. They are nearly as early as Pamir barley (vegetative period = 80 days), and have very resistant straw.

Chittyn \times *Oderbucker*, a cross made in 1909. The descendants were mixed as regards the presence of awns, but in 1914, the percentage of bearded ears had dropped to 10-15%; and it is probable that, if selection is continued, a stable, beardless type will eventually be obtained. This hybrid gave good yields in grain and straw.

Many crosses were also made between the earliest barley, Pamir, and other satisfactory varieties. Four of these hybrids, now stable, ripen very quickly (towards the middle of August), and three are beardless.

CONCLUSIONS. — All winter and spring cereals may be grown in the valley of the Yukon and its tributaries, where the short, but relatively warm and dry summer, allows them to grow and ripen in the three months' interval between the last destructive spring frost and the first autumn one, i. e., between the end of May and the end of August.

The first place is held by barley, some varieties and hybrids of which seem to unite in good proportions the most essential characters strong straw, high yield, and absence of awns (1).

406 - **The Inheritance of Glume Length in *Triticum polonicum*. A Case of Zygotic Inhibition.** — BACKHOUSE, W. O., in the *Journal of Genetics*, Vol. VII, No. 2, pp. 125-133, 5 figs. Cambridge, 1918.

PUBESCENCE. — Polish wheat (*Triticum polonicum*) is characterised by long glumes, which may reach a length of 40 mm.; the average length is 29 mm., as compared with 10 mm. in ordinary wheat. The author (Economic Botanist to the Argentine Government), having noted in 1911.

(1) According to an approximate estimation there are, in Alaska, 30,000 square miles of tillable land. It is not easy to determine how much of this area is suitable to the different cereals nor is it possible to say whether it would be practical to produce cereals in competition with the neighbouring market of the United States. Nevertheless the results of the experiments carried out so far are of great importance for agricultural science and also because some of the selected varieties obtained by hybridisation might be advantageously introduced and acclimatised in the vast lands of Russia, Siberia and Canada. (Ed.)

that in a collection of varieties of *T. polonicum* belonging to Mr. PH. DE VII-MORIN at Verrières (France), there were none with perfectly smooth glumes, and that, the shorter the glume, the more felted did it appear, proposed to study the influence of the length of the glumes on their pubescence. To this end he crossed, in 1912, a variety of *T. polonicum* having an average glume length of 29 mm., and very faintly pubescent, with a variety of *T. durum* called "Kubanka", a smooth variety with an average glume length of 12 mm. The first generation had glumes of intermediate length (18 to 19 mm.), and was much more pubescent than the parent *T. polonicum*. F_2 had plants with fully pubescent ears.

The author divides the hybrids of F_2 into 2 groups as regards length of glume:—

) short glumes (homozygotes), 10 to 14 mm. long;

) long glumes (homozygotes), 22 to 31 mm., and intermediate glumes (heterozygotes), 14 to 22 mm. long.

In F_2 there were 172 long and intermediate plants, and 55 short ones; the theoretical numbers would be 170.25 and 56.75, corresponding to the Mendelian ratio 3:1. Of the 55 short-glumed plants, 40 were felted, 15 smooth; the theoretical numbers would be 41.25 and 13.75, according to the Mendelian ratio 3:1, showing predominance of the character "pubescence".

Considering the plants with glumes from 14 to 21 mm. long as heterozygotes, only 15 out of 85 could be called really felted. The plants with long glumes (22 to 31 mm.) were all smooth, like the parent Kubanka.

Crosses between these plants with long glumes with the parent Kubanka sometimes gave, in F_2 , a mixture of rough and smooth plants showing, in the short-glumed group, the usual ratio of 3:1.

These results show that, in *T. polonicum*, long glumes inhibit pubescence, so that they remain smooth in spite of the presence of the factor determining pubescence. To obtain felted glumes, the length must be reduced.

PIGMENTATION. — The same variety of *T. polonicum* (with glumes from 18 to 29 mm. long, whitish, smooth) was crossed with a variety of *T. durum*, derived from Rivet wheat, which it resembles (glumes 11 mm. long, black, felted).

The glumes of the F_1 were intermediate in length (14 to 17 mm.), white, or slightly tinged, fairly felted. In the F_2 there were 514 long intermediate glumed plants, and 178 short-glumed ones; the theoretical numbers would be 519 and 173 in accordance with the Mendelian ratio 3:1.

The same phenomenon is observed in the coloration of the glumes as their pubescence, except that the character "black coloration of glumes" is recessive. In the short-glumed group (8 to 13 mm.) of 178 hybrids, 9 were white or tinged and 49 coloured; the theoretical numbers, corresponding to the Mendelian ratio, would be 133.5 and 44.5. All the long-glumed hybrids were white or tinged.

It may, therefore, be concluded, that the length of the glumes has an inhibitory effect on their pigmentation.

407 - Oat Selection by Pure Lines at the Agricultural Experiment Station of Highmoor, Maine, U. S. A. — SURFACE, FRANK M. and ZINN, JACOB. *Thirty-second Annual Report of the Maine Agricultural Experiment Station*, pp. 97-148. Orono, Maine, 1917.

The work described was begun in 1910 at Highmoor Farm, with 146 plants chosen from 18 of the most common commercial varieties, each being used as stock for a pure line.

In 1915, the best material, from which the poorer types had been gradually discarded, was reduced to 12 lines: —

Maine Nos. 355, 281, 351, 230, 307, 286, 357, derived from the Banner variety;

Maine Nos. 340, 337, 336, 346, derived from the Irish Victor variety;

Maine No. 247, derived from the Imported Scotch variety.

As is seen in the appended table, the selection results were distinctly positive, all the pure lines being markedly superior to the original varieties Banner, Irish Victor and Imported Scotch.

Yield in grain of the pure lines compared with the original commercial varieties.
Averages from 1913-1915.

Variety	Parent variety	Grain yield bushels per acre	Original commercial varieties	Grain yield bushels per acre
Maine No. 355	Banner	86.6	Early Pearl	82.0
" No. 340	Irish Victor	84.5	Minnesota No. 26	81.6
" No. 281	Banner	83.8	Banner	79.7
" No. 351	Banner	81.2	Gold Rain	77.8
" No. 337	Irish Victor	80.5	Stevlan	77.2
" No. 230	Banner	80.0	Prosperity	79.4
" No. 307	Banner	79.9	Irish Victor	73.2
" No. 336	Irish Victor	79.9	Imported Scotch	73.2
" No. 346	Irish Victor	79.5	Kherson	70.1
" No. 247	Imported Scotch	78.1	Swedish Select	69.7
" No. 286	Banner	77.9	Senator	64.4
" No. 357	Banner	77.4	—	—
Average		80.8	Average	73.3

As regards the shape of the panicle, the characters of the caryopsis etc., the pure lines closely resemble the original varieties. The changes in physiological characters which result in higher yield are, therefore, not necessarily associated with morphological characters.

The selected types are not only distinguished by a high yield, but also by the regularity and uniformity with which they ripen, points not always found in commercial varieties, many of which give, at the same time, early plants, over-ripe at the time of harvest, thus losing their grain easily, and

plants which are still green at harvest time, thus reducing the yield, and giving a product of unequal appearance. In all the selected plants the vegetative period (from sowing to harvest) lasts, on the average, 106 days with a minimum of 103 for Maine Nos. 340 and 337, and a maximum of 109 for Maine No. 357.

By its yield, strong straw (almost totally resistant to lodging), and the weight of its grain (1 000 weigh 40.30 gms. as against an average of 37.72 gms. for the 12 lines), Maine No. 340 is the type best adapted to the soil and climatic conditions of Highmoor.

The highest net yield was given by the line Maine No. 355 (86.6 bushels per acre), which is distinguished by its low hull percentage (27.76 %, as compared with 28.45 % for the 12 lines). On the other hand, its grain is light (35.49 gms. per 1 000) and it is somewhat subject to lodging, especially in heavy soils.

The other lines, though excellent and worthy of further trial, are nevertheless inferior to the two above-mentioned types.

The experiments are being continued with the aim of : — 1) isolating further new lines ; 2) improving those already obtained by the removal of undesirable characters ; 3) determining in each case the districts in Maine and other states best suited to each of the types which is being selected and propagated.

68 — Genetic Study on the Awns of a Variety of Six-Rowed Barley. — IKENO, SENTIRO, in *The Botanical Magazine*, Vol. XXXI, No. 370, pp. 263-267, Tokyo, October, 1917.

All the spikelets of the Japanese variety of six-rowed barley (*Hordeum sativum hexastichum*) known as "Kinukawa", have awns, which are longer in the central than the side rows.

To study the inheritance of these awns the author crossed, in both directions, the Kinukawa variety with another variety of six-rowed barley called "Noghenasi", generally beardless, but sometimes having, except on the upper part of the ear, median spikelets with very short awns.

In the F_1 generation the hybrids Kinukawa \times Noghenasi and Noghenasi \times Kinukawa both had median awns shorter than those of the parent-plant Kinukawa, whereas the lateral awns, even in the same ear, varied considerably, being : — 1) very short ; 2) entirely absent ; 3) reduced to a slight prolongation of the glume.

In the F_2 there were many forms : — 1) ear completely bearded ; 2) ear semi-bearded (awns on the median rows only) ; 3) lateral awns varying, as in the hybrids of F_1 . Moreover, in each group, the length of the awns varied considerably.

In the F_3 only 4 of the 321 plants of the F_2 gave constantly bearded progeny (like the parent Kinukawa), and only 6 gave progeny constantly beardless (like the parent Noghenasi). The average between 4 and 6 gives the Mendelian ratio 5 : 321, equal to the ratio 1 : 64, observed in cases of tri-hybridism.

The author admits the presence of three factors, or genes, which he calls A, E, and I respectively. Even in the absence of these three factors i. e., in individuals having the gametic formula aa ee ii, two varieties

of very short awns (median and lateral) may develop, but the presence of either **A** or **E** increases the length of the awns, and the simultaneous presence of **A** and **E** gives them the maximum development characteristic of the completely bearded type, Kinukawa, which has the formula **AA EE II**. On the other hand, the inhibitory factor **I** prevents the formation of awns on the lateral rows, while the median rows have long awns, in accordance with the formula **AA EE II**.

In the beardless parent, Noghenasi, (with formula **aa ee II**), the factor **I** suppressed not only the lateral awns, but also, partially or totally, the median awns. By crossing Kinukawa (**AA EE II**) with Noghenasi (**aa ee II**), were obtained in F_1 hybrids with the formula **Aa Ee II**, in which the shorter median awns and the different behaviour of the lateral awns are easily explained by the presence of **A**, **E** and **I** in the heterozygous state.

In the F_3 there are 64 gametic combinations, which may be divided into three groups: --

1) *Completely bearded ears*, in which the factor **I** is entirely absent; they number 16: -- 1 plant with the formula **AA EE II** (Kinukawa type); 2 **AA Ee II**; 2 **Aa EE II**; 4 **Aa Ee II**; 1 **AA ee II**; 2 **Aa ee II**; 1 **aa EE II**; 2 **aa Ee II**; 1 **aa ee II**.

2) *Semi-bearded or beardless ears*, in which the factor **I** is homozygous; they number 16: 1 **AA EE II**; 2 **AA Ee II**; 2 **Aa EE II**; 4 **Aa Ee II**; 1 **AA ee II**; 2 **Aa ee II**; 1 **aa EE II**; 2 **aa Ee II**; 1 **aa ee II** (Noghenasi type).

3) *Plants in which I is heterozygous*; they number 32: -- 2 **AA EE II**; 1 **AA Ee II**; 4 **Aa EE II**; 8 **Aa Ee II**; 2 **AA ee II**; 4 **Aa ee II**; 2 **aa EE II**; 2 **aa Ee II**; 2 **aa ee II**.

The problem of the distribution of the F_2 plants among these three groups may be solved by an examination of the progeny in F_3 . It is clear that the plants of groups 1 and 2 will produce exclusively bearded and beardless plants respectively, whereas those of group 3, in accordance with the Mendelian laws, will give mixed progeny composed of both entirely bearded and semi-bearded forms. The results of an analysis of F_3 were as follows: --

Composition of the F_3 generation.

	Number of plants		Percentages	
	found	calculated	found	calculated
Group I	69	80.25	0.9	1
Group II	88	80.25	1.1	1
Group III	164	160.50	2.0	2
Totals	321	321.00	4.0	4

There is, therefore an almost perfect agreement between the figures found and those calculated.

It has already been shown above that of the 16 hybrids of groups 1 and 2 of the F_2 , 4 hybrids of each group (i. e. $\frac{1}{4}$) remain constant even in the F_3 ; these are: **AA EE II**, **AA ee II**, **aa EE II**, **aa ee II**, (group 1): **AA EE II**, **AA ee II**, **aa EE II**, **aa ee II** (group 2), whereas, on the contrary, no plant

of group 3 remains constant in the F_3 owing to the presence of the factor 1 as a heterozygote. Experiments on this subject gave the following results:—

Group I (69 individuals)		Group II (88 individuals)		Group III (164 individuals)	
Number of constant individuals		Number of constant individuals		Number of constant individuals	
found	calculated	found	calculated	found	calculated
21	$17.25 \left(-\frac{69}{4} \right)$	23	$22 \left(-\frac{88}{4} \right)$	0	0

CONCLUSIONS:— 1) Three factors A, E, I, are concerned, of which the first two are found in the bearded parent Kinukawa, and the third in the beardless parent Noghenasi. Even in the absence of these three factors short median and lateral awns may be formed, but in the presence of A or E the awns are longer and, in the presence of both at the same time, the awns may be as long as those characteristic of the variety Kinukawa.

2) The factor I is inhibitory; when homozygous it suppresses the lateral awns, but does not entirely prevent the formation of median awns, which are sometimes found even in the beardless Noghenasi plants of the formula aa cc II; when heterozygous, it produces a great variety of lateral awns, sometimes even on the same ear.

3) The great differences in the length of the awns is due in particular to combinations of the two factors A and E.

499—“Reggiano Maize”, A New Variety of Early Dwarf Maize Obtained in Italy by Hybridisation and Selection. — Succi, A., in *Le Stazioni sperimentali agricole italiane*, Vol. I, Pt. 9-10, pp. 401-432, Modena, 1917.

By continual hybridisation and selection work the author has succeeded in fixing and propagating a new type of early dwarf maize, called “reggiano maize”, which is much earlier and a better cropper than that used as original material. This original variety, obtained from seed imported from America, has been cultivated since 1894 in the province of Bologna, and since 1897 in that of Reggio-Emilia, the only selection being that of the best ears.

The author describes experiments carried out by him at the experimental fields of the School of Agriculture of Reggio-Emilia, taking into consideration the following characteristics:—

Yield, earliness, length of culm, height of insertion of the ear above the ground, total number of internodes, number of internodes below the ear, length of ear and of peduncle, number of rows of seed per ear.

Of the ears selected since 1912 from the early-flowering plants, numbers 3 and 7 gave the best results, owing to the stability of their characters. In the present hybridisation experiments possible reversion to unknown types which took part in the preceding natural crosses is avoided.

Data obtained in 1914: averages of 10 culms.

	Crossings made in 1914	
	3 ♀ × 7 ♂	7 ♀ × 3 ♂
Length of culm, in centimetres.	0.83	0.81
Height of insertion of ear, in centimetres.	0.23	0.28
Total number of internodes	7.22	7.12
Number of internodes below the ear	3.55	3.60
Length of ear, in centimetres.	17.33	16.37
Length of peduncle, in centimetres.	9.44	13.40
Number of rows of grain per ear.	14.70	15.25

The characters are not constant only in the products of the reciprocal crossings 3 ♀ × 7 ♂ and 7 ♀ × 3 ♂, but also in plants resulting from self-fertilisation, so that, by a suitable fusion of the characters of the parent plants, another type — "reggiano-maize" — stable, homogenous, and really superior, tends to separate out.

Below is a summary of the methods adopted by the author to intensify still more the selection of this new type starting from the reciprocal crossings 3 ♀ × 7 ♂ and 7 ♀ × 3 ♂:

A. — SOWING. — 1) Isolate the experimental fields with protective belts so as to prevent cross-fertilisation, using, to form these belts, giant Caragna white maize, which usually flowers a month later than early dwarf maize.

2) Sow on one line only the seed from each ear.

B. — DURING GROWTH. — 3) Suppress sterile plants before the opening of the anthers.

4) Castrate the male flowers, not only of all the plants to be used for hybridisation, but also of all weak plants, or those higher or later than usual.

5) At the time of flowering mark the best plants, choosing those which are earliest and strongest.

C. — AT HARVEST AND FOR THE HARVESTED CROP. — 6) At the time of harvest choose the earliest, strongest plants, most rich in ears, normal and without disease (about 5 feet long, with 8 internodes).

7) Choose the ears:—a) inserted the lowest, i. e. at 9.82 to 11 inches from the ground at the 4th. node; b) with a peduncle about 6 inches long; c) the thickest.

8) Keep the ears enclosed in their sheath for a few days.

9) Remove the sheath and choose the ears which:—a) are thickest; b) are most typical; c) are fullest, with well-plumped grain at the top; d) have the most regular rows; e) have the most numerous rows; f) show the best characters as regards number, size, colour and fullness of grain.

10) Choose the grains on the ears, discarding:—a) those of the tip and the base; b) the most irregular; c) the more or less aborted, often found between normal grains or those above the normal.

The new type obtained by these methods from seed imported directly

South America belongs to the species *A Zea Mays* Bonaf., Class I: early maize, group a: yellow maize. Its characteristics are: —

1) Long culm, averaging 3.28 to 3.60 feet, between the first non-rooted node, on the level of the ground and the joint node of the peduncle of the male inflorescence. Total length of the plant about 4.92 ft.

2) Number of internodes: — 8 to 9.

3) Number of leaves: — 9 to 10, with strong and well developed sheath, sheath thick, causing a marked thickening at the level of the nodes.

4) Ear normal, joined at the 3rd. or 4th. node, at 9.82 to 11 inches above the ground, with peduncle about 3.93 to 5.90 inches long; bare ear, about 6.68 to 6.86 inches long, slightly conical, rounded at the tip.

5) Grain a fine, bright yellow, arranged in 16 to 18 rows, weighing, on an average 40 gm. per hundred.

6) Rachis, firm.

7) Yield, slightly inferior to that of "Agostano" maize (63 $\frac{1}{2}$ cwt. per acre as compared with 66 cwt. for the latter, according to BENDANDI the Modena Agricultural Station).

8) In the normal climate of the province of Reggio-Emilia, the new type, sown at the beginning of May, flowers in the second half of June, and ripens at the end of August.

Cultural tests made in 1912 to compare the new selected type with the original variety (seed from Bologna) confirmed the marked superiority of the new one as regards shortness and earliness; its height is only 5 feet as compared with 6 $\frac{1}{2}$ for the other, and it ripens 15 days earlier.

3. — **The Improvement of Cotton by Selection, in India.** — *Bulletin of the Imperial Institute*, Vol. XV, No. 2, pp. 149-177. London, April-June, 1917.

Selection experiments with cotton have been carried out for several years in many of the Agricultural Stations in India, and are still being continued with important results.

CENTRAL PROVINCES AND BERAR. — Selection is carried out at the Indore (Chanda District, Central Provinces) and Akola (Berar) Agricultural Stations. The following cottons are grown:

An American upland cotton called "buri".

The native cotton "bani" (*Gossypium indicum*).

The native cottons, "Jari", which include a mixture of races of *Gossypium neglectum*, *rosea*, *cutchica*, *malvensis* and *vera*.

A selected line known as k 7.

A number of hybrids, amongst them bani \times *rosea*, bani \times mathio, bani \times deshi Lahore (the last is a white-flowered variety introduced from the Punjab).

Of all the cottons studied, *rosea* gives the best yield, and is now grown on 700 000 out of the 4 750 000 acres under cotton in the Central Provinces. In 1914-15 it gave a profit exceeding that given by ordinary cotton by 21s. per acre. The yields of lint obtained from the several varieties at Akola in 1916 were:

Variety	Lbs. of lint per acre
<i>Gossypium neglectum</i> <i>rosca</i>	267.5
" " <i>cutchica</i>	255.9
" " <i>malvensis</i>	190.4
" " <i>vera</i>	171.0
Saugor jari	247.6
Berar jari	172.4
Buri	180.1
Bani	148.8
Bani X Deshi Lahore (Sindewahi cross)	184.5

PUNJAB. — The experiments are being carried out at Lyallpur with American, Egyptian, and Cambodia cottons, but only the American varieties have given positive results, and many pure lines have been isolated from the varieties acclimatised at Lyallpur. Of these 4F is distinguished by its quality and yield of its lint and by its resistance to insect pests. In 1914-5, 2 000 acres were sown with this variety, and it is hoped that in time it will replace entirely the ordinary American cotton of the district.

The native cotton of the Punjab, known as "desi", consists of a mixture of varieties of the three species *Gossypium sanguineum*, *G. indicum* and *G. neglectum*. Several main types have been isolated by selection, but they are all inferior to American cotton. Mention may be made of a form of *G. sanguineum*, which gives good yields, and is grown over 1 450 acres in the Lyallpur district.

BOMBAY. — Selection, carried out at the Mirpurkhas Farm, Sind, deals particularly with the Mitafifi (Egyptian), Sindhi (indigenous) type and several improved American Upland cottons with very long lint.

All the samples examined at the Imperial Institute in 1912-13 were of good quality. In a few cases only (Toole's, Griffen, and Black Rattler) was there a little irregularity in length or strength, but these defects might be removed by acclimatation and systematic selection of seed from the best plants.

BURMA. — The native cottons of Burma are, on the whole, of poor quality, but some of the strains have a fairly long staple, and are equal in value to the best Indian cottons, and only a little inferior to "middling" American. The most widely cultivated variety in the dry, central tracts of Burma, is "wa-galé", or "wa-pyu", which supplies $\frac{3}{4}$ of the total production of the country. Then come "wa-ni", with red fibre, grown on a small scale for local use where "wa-galé" is cultivated, the two being often mixed with "wa-gyi", a perennial cotton with white fibre, grown to a small extent in Myingyan, Thayetmyo and Minbu; "thinbaw-wa", a form of Pernambuco cotton grown in the Amherst district. From the wa-gyi and wa-galé varieties have been isolated lines with specially high ginning yields. Native cotton is inferior to Cambodia cotton obtained from Madras and now being grown in several districts.

411 - **The Effect of Selection on "Kumpta" Cotton and on the Quality of Its Fibre, in India.** — See No. 419 of this Review.

412 - **Yields of Different Varieties of Maize in Illinois.** — BURLISON, W. L. and ALLYN, O. M., in the *University of Illinois Agricultural Experiment Station, Bulletin No. 191*, pp. 409-424, 11 Tables. Urbana, Illinois, August, 1916.

CEREAL
AND PULSE
CROPS

The experiments described were carried out during 15 years, chiefly at Dekalb (Dekalb county), Urbana (Champaign county), and Fairfield (Wayne county), Illinois, and are still in progress.

The climatic conditions in the different parts of Illinois vary greatly. The rainfall in the north is 33.64 inches per annum, in the centre, 35.76 inches, and in the south, 40.25 inches. The average length of the growing season is 166 days in the north, 173 days in the centre and 188 days in the south. The soil in which the experiments are carried out is brown silt loam at Dekalb and Urbana, and grey silt loam on compact clay at Fairfield. The fields have, for the most part, been regularly supplied with phosphate rock, limestone, and either farm manure or crop residues. The methods used are those adopted by the leading maize growers.

NORTHERN ILLINOIS. — The experiments were started in 1903 at Myrtle (Ogle county), transferred in 1905 to Sycamore (Dekalb county), and, since 1906, continued at Dekalb. The rotation at Dekalb was maize, maize, oats and clover. The varieties tested were:— Riley's Favourite, Reid's Yellow Dent, Funk's 90 Day, Leaming, Goldmine, Pride of the North, Boone County White, White Superior, Western Plowman, Champion White Pearl, Silvermine, Golden Eagle, Farmer's Interest and Lockwood's Yellow Dent. Western Plowman invariably gave the highest yield with the exception of Will County Favourite, grown for two years only, and the same variety by origin. The other high-yielding varieties grown for a minimum of four years are in order of yield, Riley's Favourite, Griffith's Early Dent, Reid's Yellow Dent, Hecker's Red and Funk's 90 Day.

CENTRAL ILLINOIS. — The trials reported from Urbana have been in progress since 1901. The rotations were:— 1) maize, maize, oats and clover; 2) wheat, maize, oats and clover; 3) combination rotation of alfalfa, maize potatoes and soybeans. Of the 17 varieties tested, Reid's Yellow Dent gave the highest yield of any grown for a minimum of five years. Very good yields were obtained with Boone County White, Champion White Pearl, Leaming, Silvermine and Riley's Favourite, while Golden Eagle, Farmer's Interest, Johnson County White and Beatty's Yellow proved highly satisfactory.

Fifteen varieties were also tested at Decatur, Auburn, Mattoon and Sibley. In these trials Reid's Yellow Dent was out-yielded by three varieties. — Funk's Yellow Dent, Farmer's Interest and White Superior — but the difference was not marked, and the varieties only tested for two years.

SOUTHERN ILLINOIS. — The tests were started in 1906. The highest yields for a minimum of four years were obtained with the following varieties in the order given: — Funk's 90 Day, Reid's Yellow Dent, Perrine's White Pearl and Chinese Poor Land. Sutton's Favourite, Strout's Red,

Will County Favourite and Western Plowman, though grown for one year only, promise well.

Experiments were also made on untreated land at Fairfield. They gave the expected results; i. e. varieties grown commonly in southern Illinois adapted to the soil out-yielded those which gave the best results under less unfavourable conditions. In these trials Champion White Pearl, Perine's White Pearl and Easterly's White varieties gave the highest yields for the three years 1911-1913.

The bulletin concludes with a brief history of certain varieties of maize.

413 — **A New Early Variety of Dwarf Maize, Obtained in the Province of Reggio Emilia, Italy.** — See No. 409 of this Review.

414 — **Indo-Chinese Rice.** — CAPUS, G., in *Annales de Géographie*, Year XXVII, No. 145, pp. 25-42. Paris, January 15, 1918.

The methods of increasing the production of rice in Indo-China and of improving its quality are discussed. The different varieties grown ("Gocong" or "Kadong", "Baixan" and "Vinhlong" or "Longho") should be sorted, both for milling and for exportation. The selection of seed is prevented by the hold of the Chinese over the rice trade. The Chinese buy the rice in small lots, which they mix for sale. The only method of opposing this practice would be by founding European factories which would insist on sorting when buying.

At the exhibition organised in 1911 by the Colonial Institute of Marseilles were 796 samples of rice from Cochinchina, together with information on their origin, yield per acre and weight of grain per bushel. An investigation into the commercial value of the hulled rice showed that, besides very many valuable varieties, 14 at least, qualified as very valuable, were particularly mentioned because of their commercial qualities. The value of the white rice of 19 varieties was stated to be equal to those quoted at 10s. to 15s. per cwt.

Special stress is laid on: — 1) the usefulness of improving the quality and yield by the choice of seeds from the best native varieties (a method superior to the introduction of good foreign varieties, for this is often difficult and the introduced varieties degenerate rapidly); 2) individual selection; 3) the use of pure and pedigreed lines; 4) the improvement of the crops.

Cochinchina produces annually over 2 million metric tons of paddy on 3 706 650 acres of rice fields. If an increase of 20 % of the present yield were obtained, the annual gain would be 400 000 metric tons, representing a value of about £ 158 590. The annual production of about 5 million metric tons of the three rice-growing countries of the Union (Cochinchina, Cambodia and Tonkin) would increase by about 1 million tons, worth, at the normal local price of paddy, £ 396 500.

415 — **The Composition of the Potato Plant at Various Stages of Development.** — RAMSAY, J. T. and ROBERTSON, W. C., in *The Journal of the Department of Agriculture*, Victoria, Vol. XV, Pt. 2, pp. 641-655 + 2 figs. Melbourne, November, 1917.

Object of the experiment. — This experiment was carried out to determine: — 1) the rate of assimilation of food from the soil; 2) the relative

proportion of each of the principal elements contained in the plant at various stages of its growth.

Method. — The crop was grown in synthetic soil composed of 13 parts barium sand, 2 parts clay loam surface soil and 1 part well-rotted farmyard manure. When well mixed its composition per 100 000 parts was, nitrogen 203, phosphoric acid 22, potash 82, lime 201, magnesia 55. It was put in small 18 × 18 × 18 inch hardwood boxes, each of which held 130 lbs. of soil. The potatoes were planted 4 inches below the surface, and the boxes placed in the ground, their top being practically level with the surface. Care was taken to ensure good draining and the plants were well watered. Each box received as fertiliser: — superphosphate $\frac{1}{2}$ oz., ammonium sulphate 1 oz., dried blood 1 oz., potassium sulphate $\frac{1}{2}$ oz. The potatoes were planted on December 17, 1916. All the potatoes were of the Up-to-Date variety and their average weight was 75 grams. When the plants emerged a top dressing of $\frac{3}{4}$ oz. of sodium nitrate per box was applied. Later each box was mulched with buffalo grass (*Buchloe distachyoides*) cuttings, and the surface soil was kept loose throughout the period of growth.

Harvests. — The harvests were at intervals of approximately one month see Table I. The total period of ripening was 124 days. Care was always taken to collect the whole plant without damaging or tearing the root.

Results. — The results were remarkably uniform in the duplicate sets from each harvest, they are summarised in the following tables.

TOTAL DRY MATTER IN THE PLANT.

TABLE I. — *Yield of dry matter at various stages of growth.*

Date of harvest	Grams of dry matter per plant				Dry matter per acre (12 000 plants per acre)			
	Haum	Tubers	Roots	Total	Haum	Tubers	Roots	Total
					lb.	lb.	lb.	lb.
1st. (January 19)	49.41	3.44	6.29	59.14	1 741	121	221	2 072
2nd. (February 23)	158.90	147.10	14.32	320.32	5 600	5 184	504	11 288
3rd. (March 26)	219.50	352.35	15.31	587.16	7 285	12 418	539	20 692
4th. (March 30)	213.00	423.40	10.70	647.10	6 506	14 921	377	22 804

TABLE II. — *Approximate acre green weight of potatoes at the different harvests.*

Tgt of tubers per acre . . .	1st.		2nd.		3rd.		4th.	
	tons	cwt. qrs. lbs.	tons	cwt. qrs. lbs.	tons	cwt. qrs. lbs.	tons	cwt. qrs. lbs.
	0	4 0 6 8	13	2 8 20	15	3 4 24	18	3 0

TABLE III. — *Approximate percentage production.*

Harvest	Root %	Haulm %	Tuber %
1st.	11	83.5	5.8
2nd.	3.5	42	55.0
3rd.	0.3	23	77.0
4th.	—	—	100.0

TABLE IV. — *Analysis of seed sets at various harvests.*

	Average weight of dry matter		Nitrogen		Phosphoric acid		Potash		Lime	Magnesia
	gm.	%	gm.	%	gm.	%	gm.	%	%	%
Original set . . .	14.95	1.35	0.20	0.32	0.048	2.84	0.42	0.10	n. e.	n. e.
At 1st. harvest. .	12.17	0.70	0.09	0.29	0.035	4.13	0.50	n. e.	n. e.	n. e.
At 2nd. " . . .	9.61	1.52	0.12	0.28	0.027	4.75	0.45	n. e.	n. e.	n. e.
At 3rd. " . . .	5.80	1.75	0.10	0.33	0.020	4.90	0.28	n. e.	n. e.	n. e.
At 4th. " . . .	4.70	2.04	0.10	0.43	0.022	5.15	0.24	n. e.	n. e.	n. e.

n. e. = not estimated.

The results in these tables show distinctly that the potato plant does not develop in a uniform manner throughout the period of its growth. The development of the root practically ceases at the end of the second month when 93% of the root are already formed. The development of the haulm ceases after the 3rd. month; only the tubers continue to grow during the 4th. month. During the 1st. month the plant produces 9% of its total dry matter, 50% during the 2nd., and 91% during the 3rd. Thus the life of the potato really includes three cycles—preparation (it is here the plant needs assistance), production, maturation.

The results obtained by the authors agree with those obtained by E. WILFARTH and H. ROMER at the Ducal Agricultural Station at Bernburg, Anhalt (Germany), in 1903-1904. These workers carried out experiments on a much larger scale to determine whether, during growth, the potato plant returns part of its food to the soil.

The principal results may be summarised as follows:—

- 1) The 3 essential plant foods—nitrogen, potash and phosphoric

TABLE V. — *Chemical composition of the potato plant at the different harvests (total dry matter)*

Harvest	Composition, per cent.					Yield in lbs. per acre (12 000 plants per acre)				
	Nitro- gen	Phosphoric acid	Potash	Lime	Magne- sia	Nitro- gen	Phosphoric acid	Potash	Lime	Magne- sia
<i>Haulm.</i>										
1. 4.82	1.02	7.15	1.69	1.25	62.9	13.3	91.7	22.1	16.3	
2. 3.91	0.93	6.23	1.62	1.08	164.2	39.0	261.7	68.0	45.4	
3. 2.47	0.36	4.58	2.18	1.16	143.3	20.9	265.7	126.5	67.3	
4. 1.99	0.33	3.74	2.33	1.14	112.2	18.6	210.9	131.4	64.3	
<i>Tubers.</i>										
1. 1.98	0.97	4.65	0.15	0.22	1.8	0.9	4.2	0.14	0.20	
2. 1.79	0.82	2.98	0.10	0.14	69.5	31.9	115.8	3.90	5.40	
3. 1.68	0.66	3.08	0.11	0.19	156.4	61.5	286.9	10.20	17.70	
4. 1.80	0.69	3.20	0.15	0.20	204.9	77.4	358.9	16.82	22.40	
<i>Roots.</i>										
1. 2.60	0.75	3.70	1.30	0.76	4.3	1.2	6.0	2.1	1.25	
2. 2.02	0.83	2.12	1.27	0.66	7.6	3.2	8.0	4.8	2.50	
3. 1.72	0.35	1.52	1.40	0.73	6.0	1.4	6.0	5.7	2.90	
4. 1.88	0.40	0.82	1.31	0.71	5.3	1.1	2.3	3.7	2.00	
<i>Whole plant.</i>										
1. 4.22	0.99	6.53	1.5	1.10	69.0	15.4	102.0	24.3	17.8	
2. 2.85	0.87	4.55	0.9	0.63	241.3	74.0	385.4	76.7	53.3	
3. 1.97	0.54	3.60	0.9	0.56	306.7	83.8	558.7	112.4	88.8	
4. 1.86	0.56	3.32	0.9	0.52	319.0	97.0	573.0	152.0	90.0	

* Owing to the advanced stage of decomposition difficulty was experienced in collecting the roots at the 4th. harvest. The loss was about 30 %, which would make the analytical results obtained from the 4th. harvest of the roots about equal to those obtained from the 3rd.

d — once absorbed by the potato plant are utilised, no migration in the plant to the soil taking place.

2) The critical period of growth is the first 6 to 8 weeks.

3) The greater part of the phosphoric acid enters the plant at the early stage of growth, concentrating in the haulm, and then playing an important part by migrating to the stolons for tuber formation.

4) Potash and nitrogen play a consistently even part throughout growing period.

5) Practically the whole of the root development takes place during first 2 months.

TABLE VI. — *Plant-food ratio in the roots at the different harvests.*

Harvest	Phosphoric acid	Nitrogen	Potash	Lime	Magnesia
<i>Haulm.</i>					
1st.	1	4.7	7.0	1.6	1.2
2nd.	1	4.2	6.7	1.7	1.1
3rd.	1	6.8	12.9	6.0	3.2
4th.	1	6.6	11.3	7.0	3.5
<i>Tubers.</i>					
1st.	1	2.0	4.8	0.15	0.2
2nd.	1	2.2	3.6	0.1	0.2
3rd.	1	2.5	4.6	0.2	0.3
4th.	1	2.3	4.0	0.2	0.3
<i>Roots.</i>					
1st.	1	3.5	5.0	1.8	1.0
2nd.	1	2.4	2.5	1.5	0.8
3rd.	1	5.0	4.4	4.0	2.0
4th.	1	4.7	2.0	3.3	1.8

TABLE VII. — *Soluble plant-food in the potato haulm at the different harvests.*

Harvest	Nitrogen		Phosphoric acid		Potash	
	% soluble	of total in plant	% soluble	of total in plant	% soluble	% of total in plant
1st.	1.55	32	0.81	80	7.13	110 (approx)
2nd.	0.80	20	0.67	72	5.34	86 (")
3rd.	0.77	30	0.27	75	4.50	100 (")
4th.	0.42	21	0.27	80	3.54	100 (")

6) Haulm development is most active during the first 2 months

7) The amounts of lime and magnesia assimilated by the potato plants seem to bear a definite relation.

8) The very young potato tuber is richer in phosphoric acid than semi or mature tuber.

9) Phosphoric acid and nitrogen present in the seed set are largely utilised for sprout formation (25 % for the former and 50 % for the latter). Potash, apparently, is not utilised directly.

10) The results of the experiments taken collectively show that the plants must be manured during the first month.

11) Potatoes can be grown on poor sandy soil provided that available plant-food in the form of artificial fertilisers and farmyard manure are present.

ciously applied. In such cases the quantity and quality of the produce may be favourably compared with that from the best potato soils.

12) The value of the dried haulms and roots may be compared to farmyard manure in favour of the dried haulms, 1 ton of which supplies 3 times as much nitrogen and phosphoric acid, and about 10 times as much potash as 1 ton of farmyard manure.

13) The composition of the potato tuber under experimental conditions may be influenced in so far as the phosphoric acid content is concerned.

14) During the growing period the potato plant utilises phosphoric acid, nitrogen and potash, in the proportion of 1, 4, 6, *i. e.* 1 part of phosphoric acid to 4 parts of nitrogen to 6 parts of potash.

16 - **Methods of Applying Fertilizer to Sweet Potatoes.** — DURST, C. E., in the *University of Illinois Agricultural Experiment Station, Bulletin* No. 188, pp. 268-278, 2 Figs., 6 Tables. Urbana, Ill., April, 1916.

Fertiliser experiments with sweet potatoes were carried out during the years 1910-1914 at Anna, in Union County, the most important sweet-potato growing centre. Eight plots, each 66 × 20 feet, were used; two of these (plots 1 and 5) were control plots, three (plots 6, 7, and 8) were fertilised under the ridge, and three (plots 2, 3 and 4) were fertilised broadcast, each with:—1) home mixed fertiliser (2 parts by weight of steamed bone, with 12.5 % phosphorus, 2 parts of dried blood, with 14 % nitrogen, and 1 part potassium sulphate, with 42.5 % potash); 2) 640 lbs. manure, containing 10 lbs. nitrogen, 3 lbs. phosphorus and 8 lbs. potash per ton; 3) 16 lbs. steamed bone.

The potatoes harvested were graded according to the local method into "table" potatoes (1½ inch or more in diameter, of good shape), "seed" potatoes (of good shape and rather smaller than the first class), and "strings" deficient in size and shape). The average yields obtained were:—

Plot	Table potatoes, bushels per acre.	Seed potatoes, bushels per acre.	Strings % in weight of table potatoes
1	76.07	35.17	24.29
2	91.16	33.32	20.93
3	106.42	33.82	20.74
4	89.57	33.51	20.57
5	80.96	30.03	26.57
6	103.28	29.12	25.41
7	130.92	28.15	19.26
8	100.79	33.38	20.76

As the price of sweet potatoes varies according to the season in which they are marketed the results given have been based on two set prices:—50 cents per bushel for the table grade and 25 cents per bushel for the seed grade; 2) 75 cents per bushel for both grades (price of stored potatoes).

All the fertilised plots gave higher unit yields than the control plots, and only manure and steamed bone under the ridge gave a sufficiently great increase to bring in any appreciable profit when the cost of the fertiliser

and the elements left in the soil are taken into account. All the treatments supplied more of the elements for which they were used than was removed by the crop. Manure applied under the ridge not only gave the highest net returns, but also left more fertiliser value in the soil than any of the other treatments except manure broadcast. Manure also leaves considerably more organic matter in the soil than does any other fertiliser.

Conclusions. — All the fertiliser treatments tested in the experiments increase both the unit yields and the percentage of table potatoes. With the possible exception of the home-mixed fertiliser, higher percentages of table potatoes are produced when the fertiliser is applied under the ridge than when it is broadcast. When considering the advisability of any of these treatments, the prices likely to be received for the crop should be taken into account, as the higher these are, the greater is the profit made on the fertiliser.

A large proportion of the fertiliser remains in the soil for the next crop.

417 — **Grasses and Other Fodder Plants of Victoria, Australia.** — AUDAS, J. W., in *The Journal of the Department of Agriculture of Victoria*, Vol. XV, Pt. 12, pp. 711-723, 3 Tables, 3 Figs. Melbourne, December, 1917.

NATIVE FODDER GRASSES. — The native grasses of Victoria belong to 136 species, divided among the following 49 genera : —

Panicum, 15 species; *Chamaecraphis*, 2; *Isachne*, 1; *Oplismenus*, 1; *Setaria*, 1; *Syntherisma*, 2; *Tragus*, 1; *Neurachne*, 3; *Zoysia*, 1; *Imperata*, 1; *Pollinia*, 1; *Lepturus*, 2; *Illecebraria*, 1; *Andropogon*, 8; *Chrysopogon*, 2; *Sorghum*, 2; *Anthistiria*, 2; *Alopecurus*, 1; *Tetrarrhena*, 3; *Microstachya*, 1; *Hierochloa*, 2; *Aristida*, 6; *Stipa*, 13; *Dichelachne*, 2; *Pentapogon*, 1; *Amphipogon*, 1; *Pappophorum*, 1; *Sporobolus*, 3; *Agrostis*, 3; *Deyeuxia*, 7; *Deschampsia*, 1; *Trisetum*, 1; *Anisopogon*, 1; *Danthonia*, 6; *Cynodon*, 1; *Chloris*, 2; *Eleusine*, 1; *Poa*, 1; *Glyceria*, 5; *Diplachne*, 2; *Triodia*, 1; *Distichlis*, 1; *Bromus*, 1; *Eragrostis*, 7; *Elychophorum*, 1; *Trinaphis*, 1; *Agropyron*, 3; *Arundo*, 1.

All are fairly well distributed throughout the state. The most valuable and nutritious grasses amongst them are 15 species of *Panicum*, 8 of *Andropogon*, 7 of *Deyeuxia*, 7 of *Eragrostis* (some of which are remarkable for their resistance to drought), 4 of *Glyceria*, 2 of *Anthistiria*, 2 of *Chloris*, 2 of *Diplachne*, 4 of *Poa* (one of which might be used for the manufacture of fibre), 3 of *Sporobolus* (one of which could be used in paper-making).

On the other hand, there are a large number of undesirable grasses, covering, in some places, a wide area, depreciating its stock-carrying capacity. They are : —

Stipa elegantissima; *S. flavescens*; *S. teretifolia*; *S. eremophila*; *S. setacea*; *S. Luckmanni*; *S. acroclitata*; *S. McAlpini*; *S. Muelleri*; *S. semibarbata*; *S. pubescens*; *S. australis*; *S. scabra*; *Aristida arcuata*; *A. Behriana*; *A. lepidopoda*; *A. vagans*; *A. ram-osa*; *A. calycina*; *Triodia irritans*, the last chiefly on account of its sharp-pointed leaves.

NATIVE PASTURE GRASSES : —

Andropogon pertusus, pitted grass; *A. affinis*, crown beard grass; *A. refractus*, turpentine grass; *A. sericeus*, silky blue grass; *Agropyrum scabrum*, common wheat grass; *Anthistiria imberbis*, kangaroo grass; *Chloris truncata*, windmill grass; *C. acicularis*, lesser star grass; *Cynodon Dactylon*, Indian couch grass; *Danthonia penicillata*, Wallaby grass; *Dichelachne*

nitio, long hair plume grass; *Eleusine cruciata*, finger grass; *Eragrostis Brownii*, common ve grass; *E. pilosa*, soft love grass; *Microloena stipoides*, weeping grass; *Panicum decompositum*, umbrella grass; *P. divaricatissimum*, spider grass; *P. effusum*, hairy panic grass; *gracile*, slender panic grass; *P. leucophacum* cottony panic grass; *P. Mitchellii*, spreading nic grass.

NATIVE GRASSES FOR MOIST SOILS : —

Glyceria fluitans, manna grass; *G. Fordiana*, sweet swamp grass; *G. ramigera*, bamboo as; *Hemarthria compressa*, mat grass; *Imperata arundinacea*, blade grass; *Panicum melan- mium*, black seeded panic grass; *Arundo Phragmites*, common reed grass; *Microloena sti- des*, weeping grass; *Isachne australis*, swamp millet; *Diplachne fusca*, brown beetle grass; *ulthonia nervosa*, swamp Wallaby grass.

NATIVE GRASSES FOR DRY SOILS : —

Amphipogon strictus, bearded heads; *Antipogon arenaceus*, oat spear grass; *Echi- pogon acutus*, hedge hog grass; *Eragrostis lacunaria*, Mullee love grass; *Neurachne Mitche- lii*, Mitchell mulga grass; *Pappophorum nigricans*, nigger head; *Pollinia fulva*, browntop; *onis truncata*, windmill grass; *Eleusine cruciata*, finger grass; *Panicum effusum*, hairy tic grass; *P. prolatum*, pallid panic grass; *P. decompositum*, umbrella grass.

NATIVE GRASSES FOR BINDING SANDS : —

Distichlis maritima, salt grass; *Imperata arundinacea*; *Festuca littoralis*, coast fescue; *nilex hirsutus*, hairy spinifex; *Sporobolus virginicus*, Virginian rat-tail grass; *Zoysia pun- s*, prickly couch grass; *Hemarthria compressa*; *Cynodon Dactylon*.

During spring and summer there is generally abundant, rich pasture, t the want of it is usually felt in winter. One of the most common grasses *Danthonia penicillata*; it is very nutritious and relished by all kinds of ck. *Anthistiria imberbis* produces little seed, and it is advisable to remove ck from it during spring and summer; if this is done it grows sufficiently h to hide sheep, which like it very much. Stock willingly eat *Imperata ndinacea*, which is also used for thatching. *Panicum Crus-Galli* attains eight of 4 to 5 feet, and is most suitable for moist districts. Perennial : *Pappophorum nigricans*; *Eragrostis Brownii*; *Amphipogon strictus*; *nium divaricatissimum* (drought-resistant); *P. gracile*; *Microloena sti- des*; *Hemarthria compressa*; *Festuca littoralis*; *F. duriuscula* (composition grass dried at 212° F: — soluble albuminoids, 0.44 %; insoluble albumin- is, 3.94 %; digestible fibre, 17.18 %; woody fibre, 60.99 %; soluble eral matter, 4.01 %; insoluble mineral matter, 2.26 %; chlorophyll, ible carbohydrates, etc., 11.18 %; the grass contains 61.98 % of water).

NATIVE WILD FODDER PLANTS OTHER THAN GRAMINEAE : —

Trigonella suavisissima, sweet fenugreek; *Erodium cymosum*, blue Erodium; *Geranium atum*, cut-leaved geranium; *Leucosia phleba*, austral holly-hock; *Deucus brachiatus*, aus- carrot; *Plantago varia*, variable plantain; *Lotus corniculatus*, birdsfoot trefoil.

EXOTIC FODDER PLANTS NATURALISED IN VICTORIA : —

GRAMINEAE : — There are about 95 species, many of which are widely tirated. The best are : —

Doctylis glomerata; *Lolium perenne*; *Poa pratensis*; *Bromus unioloides*; *Sorghum hale- se*; *Phleum pratense*; *Festuca daltior*; *Alopecurus pratensis*; *Cynosurus cristatus* (drought- stand); *Anthoxanthum odoratum*; *Trisetum pratense*; *Paspalum dilatatum*; *Agrostis alba*; *ium effusum* (the two last for damp soils).

Ammophila arundinacea and *Elymus arenarius* are very useful for fixing sand; both are refused by stock, but are excellent for thatching.

ACCLIMATISED LEGUMINEAE AND FODDER PLANTS OF OTHER FAMILIES:—

Trifolium repens; *T. hybridum*; *P. pratense*; *T. fragiferum*; *T. resupinatum*; *T. subterraneum*; *T. tomentosum*; *T. glomeratum*; *T. incarnatum*; *T. minus*; *T. parviflorum*; *T. procumbens*; *T. striatum*; *Medicago sativa*; *M. tribuloides*; *M. maculata*; *M. denticulata*; *M. orbicularis*; *M. scutellata*; *M. lupulina*; *Melilotus alba*; *M. parviflora*; *Poterium Serratorba*; *Plantago lanceolata*; *Vicia sativa*; *Anthyllis vulneraria*; *Onobrychis sativa*; *Trigonella ornithopoides*.

418—Bokhara or Sweet Clover (*Melilotus alba*) in New South Wales. — BREAKWELL, E., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 10, pp. 731-734, 1 fig. Sydney, October, 1917.

The fact that Bokhara or sweet clover (*Melilotus alba*) is one of the most widely cultivated fodder plants in the United States, lead to cultivation experiments being made with it in New South Wales, on the Glen Innes and Yanco farms. It is generally a biennial plant, but, in the two districts mentioned it flowered to a small extent during the first year, and seeded heavily during the second. The abundant flowers are very attractive to bees, which give a large yield with it.

TRIALS AT GLEN INNES. — Sweet clover, sown on September 10, 1915, in rows 2 $\frac{1}{2}$ ft. apart on $\frac{1}{10}$ acre, germinated well (75 %) and made good growth during the dry spring and the summer. The main stem was not very high, but the secondary ones were numerous and long. From the first year the spaces between the lines were completely filled, and there was a profuse yield of tender, but bitter, fodder. The winter frosts destroyed the aerial parts of the plants, but they grew again strongly in Spring. On November 20 the plants were 3 ft. high, on January 20, from 7 to 8 ft. high, and were setting seed well. The ripe plants are woody, and they should be grazed or cut for hay when still young. Horses, cattle and sheep will not eat it green.

TRIALS AT YANCO. — Comparative trials were made with American seed and seed bought in Australia. The first gave 6.4 times more green fodder than the other. Both are deep-rooters.

The advantages of sweet clover are: — it is excellent for bees; it eradicates weeds; it is a good green manure; it prepares the soil for lucerne by breaking it to a great depth with its roots and enriching it with the nodular bacteria essential to the growth of lucerne. Its disadvantage lies in the coumarin it contains, which gives it a bitter, unappetising taste. Opinion on this subject is contradictory, and it appears that animals eventually become accustomed to it and eat it willingly.

419—The Selection of Kumpta Cotton in India. — KOTTUR, C. I., in *Department of Agriculture, Bombay, Bulletin* No. 84, pp. 1-2. Poona, 1917.

Practical advice on the choice of stock plants of the "Kumpta" variety is given. The plants should have the following qualities: — 1) well-developed stem with many internodes; 2) high ginning percentage; 3) pod with long, fine, strong staple. The plants in which the capsules open prematurely should be removed as they give only little lint of low quality.

The seed thus obtained should be sown in lines, all the seeds of one plant in one line. At the time of harvest the seed from the best line may be distributed as selected seed. These simple methods, which may be adopted by all growers, have already given appreciable results, as is seen below:—

	Yield per acre		Ginning per cent	Value per candy *
	Kapas	Clean cotton		
	lbs.	lbs.		
Kumta " unselected . . .	564	148	26.2	335 rupees **
Kumta " selected	612	171	28.0	350 "

* 1 candy = 784 lbs. — ** 1 silver rupee = 1s. 4d. at par.

It is seen that selected cotton is superior to unselected cotton both in yield and the quality of the product.

o - Ambari or Deccan Hemp, *Hibiscus Cannabinus* L., in South Africa. — FORD-EVANS, I. B., in *The South African Journal of Industries*, Vol. I, No. 3, pp. 198-208, 6 Plates. Pretoria, November, 1917.

Hibiscus cannabinus L., known in the British colonies as Ambari Hemp, Deccan Hemp, Gambo Hemp and Bimlipatam Hemp, is called in South Africa "the wild stock rose" (1). Up to the present it has been practically unknown in this district as a fibre plant.

The importance of the cultivation of this plant is pointed out, and the attention of farmers and merchants in particular is drawn to it. The botanical and cultural characteristics of the plant are described, and stress is laid on the value and industrial use of the fibre. The results are also given of an examination made by the Imperial Institute of samples of *Hibiscus cannabinus* fibre grown in the Transvaal, and these results show it to be of good quality.

The extraction of the fibre has been studied in the Botanical Laboratory, Pretoria, and it has been shown that there would be no difficulty in retting under South African conditions. The length of time required for immersion in water of a temperature varying from 18 to 26° C. is from 10 to 14 days. A 10.7 to 11.9% yield of fibre of excellent quality has been obtained.

Before *Hibiscus cannabinus* can be recommended to growers for cultivation it is necessary to make a further study of the plant and its fibre, to investigate the questions of a market for it in South Africa, of the profit the grower may realise, and the best varieties to be grown, both as regards yield and the quality of the fibre. Such a study would require at least five years and careful investigation both in the field and in the laboratory. *Hibiscus cannabinus* does well in many parts of South Africa, and there appears no reason why it should not give as good results there as in India.

(1) It is the "da", or "dah", of French West Africa. (Ed.)

421 - Contribution to the Chemical Study of the Nuts of "Sanga-sanga" or *Ricinodendron africanum*.—PIERAERTS, in the *Annales du Musée colonial de Marseille*, Year XXV, Series, 3, Vol. V, pp. 27-37. Paris, Marseilles, 1917.

The author (Keeper of the Belgian Congo Museum) has made a chemical study of the nuts of *Ricinodendron africanum* Mull. Arg. (fam. Euphorbiaceae), sent to him from Ganda-Sundi (Lower Congo). *R. africanum* known as "sanga-sanga" in that country, "essang", "enguessang", "issanguila" in the French Congo and Gabon, and "usa sana" in the other countries of west equatorial Africa. It is a tree some 80 to 100 feet high, 10 feet round, with very spongy wood of poor quality, not even good enough for heating. Its nuts are about the size of a hazel-nut and weigh from 1.25 to 2.400 gm; with its extremely hard, black shell it will keep a long time.

The nut has a very wrinkled surface, and is composed of: — 1) the shell (endocarp), very hard, black outside and milky white inside; 2) the kernel (really the seed), completely filling the shell in sound specimens. The unsorted nuts give 72 % of shell and 28 % of kernel. The kernel gives

Moisture	17.64 %
Dry matter	82.36 %
Total mineral matter	7.32 % of the dry matter
Total mineral matter insoluble in water	6.70 % of the dry matter

That is, 01.53% of the total ash for the last two.

On extraction with anhydrous ether, the kernel gives 55.29 % of oil (i. e., 67.3 % of the dry matter), which corresponds to a content of 18.52 % for sorted nuts and 15.48 % for unsorted nuts. The oil extracted is limpid, pale yellow, and of a sweet flavour, leaving an earthy taste; it has no special odour. It has the following characteristics: —

Specific weight at $\frac{15^{\circ}}{15^{\circ}}$	0.9345
Critical temperature of solution in absolute alcohol	90.2°
Refractive index at 19.5°	1.5028
Polarimetric test	$\alpha_D = + 0.01^{\circ}$
Acid index	0.86
(calculated as oleic acid, it is 0.43 %).	
Maumene test	79°
Bromides insoluble in ether	nil.
Insoluble and unsaponifiable fatty acids	98.85 %
Glycerine	9.77 %
Saponification index	194.4
Elaidin test (very viscous, brownish-yellow mass)	
Melting point	32.3° to 34.5°C.
Saponification point (the melted acids remain in fusion at laboratory temperature (20°C) and only resolidify after two hours).	

The action of the air (and possibly of light as well), on "sanga-sanga" oil constitutes, as regards the drying properties, a complex chemical problem. As regards the action of iodine, the oil dissolved in chloroform, used for the polarimetric examination, was poured, while continual shaking, into an equal volume of a saturated solution of iodine in chloroform

after a few moments the mixture set in a gelatinous mass of such a consistency that it did not flow on inverting the beaker.

The refractive index of the oil is higher than that of any other vegetable oil known, save abrasin oil. "Sanga-sanga" oil is a drying oil; it seems more drying than linseed, as it solidifies much more quickly. It might well be used for waterproofing, as a mastic for caulking ship's hulls or other objects having joints needing stopping up, and as mortar or lamp oil.

The kernel cake has an exceptionally high nitrogen content; its phosphoric acid content is also very high. This cake would be excellent as a fertiliser for nurseries, gardens, etc. If it proves to contain no toxic matter, it would provide a first class food for live stock and poultry.

422 - **Commercial Onion Growing in Indiana.** — SAYRE, C. B. (under the direction of WOODBURY, C. G.), in *Purdue University Agricultural Experiment Station, Circular No. 57*, pp. 27, 12 Fig. Lafayette, Ind., September, 1916.

HORTICULTURE

Onions are grown very extensively on the peat or muck soils of northern Indiana, the crop of 1914 amounting to 2 210 325 bushels.

Good drainage is an important factor in selecting muck soil for profitable onion growing. The soil should be well prepared before planting; many growers prefer to prepare the land in autumn. Rolling is of great value.

Potash is the element most deficient in the non-acid muck soils, and muriate of potash applied at the rate of 200 to 400 pounds per acre will give a very profitable increase in yield with normal prices. Acid phosphate at the rate of 300 to 400 pounds per acre can usually be applied profitably to the muck soil for onions. The acid muck soils are especially deficient in phosphorus, and larger amounts should be applied to them. Nitrate fertilizers can seldom be applied with profit to the muck soils. Lime cannot be applied with profit except to the acid muck soils. Manure is the best all around fertilizer for onions, but under normal conditions chemical fertilizers can be applied most economically to the muck soils. The manure should be well rotted.

The great bulk of the onions grown on the Indiana muck soils are for autumn and winter use, and for this purpose the yellow globe type is the most commonly grown, although the red globe varieties are also very popular. The white varieties are grown principally for pickling. Of the yellow type there are several varieties which are commonly grown. The Southport yellow globe is the most popular yellow variety, while the Ohio yellow globe and yellow globe Danvers are grown to a lesser extent. Of the red varieties, the Southport red globe is most popular, and the Red Wethersfield and Ohio red globe are also grown. Of the white varieties, the Southport white globe is preferred for large, mature white onions, while the white Portugal and Silver Skin are popular varieties for pickling.

Onion seed should be sown in rows 12 to 14 inches apart at the rate of 3 ½ to 4 lb. per acre as early in the spring as the ground can be worked. Frequent cultivation with wheel hoes, and two or three hand weeding are necessary. The onions are harvested about September 1. The best growers average over 500 bushels per acre, which sell at an average of 40 cents per

bushel. It costs about \$75.00 to produce an acre of onions. A large part of the Indiana crop is stored.

Onion sets and pickling onions are grown extensively in Lake county. The culture is similar to that of large onions, except that the small onions are produced by thick seeding (50 to 80 lb. per acre). Onion seed is grown successfully by some of the large growers of Indiana.

There are three insect pests, namely thrips, maggots and cutworms, which sometimes cause considerable loss to the onion growers in northern Indiana.

The onion thrips (*Thrips tabaci*) chafes off the epidermis of the leaves, principally at their base, producing yellowish, gray irregular spots on the leaves, later causing the entire leaf to dry up and die. In order to spray onion thrips successfully, high pressure (at least 100 lb.) and a fine mist-like spray which can be directed into the base of the onion leaves are necessary. A gasoline outfit or good hand pump outfit equipped with a long line of hose and extension rod is the most satisfactory type that has been used thus far. The following spray material is very efficient if it comes in actual contact with the insect:— concentrated nicotine sulphate, 5 oz.; whale oil soap, 4 lb.; water, 50 gals. The spray should be applied when the thrips first appear and the onions are small and easily sprayed. It will probably have to be repeated 2 or 3 times at intervals of 10 days in order to destroy succeeding generations as they hatch.

The onion fly (*Phorbia ceparum*) lays its eggs in the sheath of the onion when the plants are very small. The eggs hatch in about 10 days and the maggots burrow into the bulbs of the onion, causing the loss of the plant. Sometimes whole fields are thus ruined. A second and sometimes a third brood appears later in the season. Field hygiene is especially important in controlling onion maggots. A new method of control devised at the Wisconsin Experiment Station, is claimed to give excellent results. This treatment, called the "poison bait spray", destroys the flies which lay the eggs. It is used as follows:— as soon as the onion seedlings appear, the first spray should be applied, and it should be repeated at intervals of 5 days or a week during the period when the flies are present. The spray consists of one ounce of sodium arsenite, 2 1/2 quarts of New Orleans molasses and 5 gals. of water. The arsenite should be dissolved in boiling water and the molasses added and thoroughly mixed. This bait must be applied, by means of a whisk broom or of a spray outfit with a coarse nozzle, in large drops along the rows so that the flies can drink it. After onions have become infested with maggots, there is nothing that will remedy the difficulty that season, but infested plants should be promptly removed and burned in order to reduce the number of insects that will appear the following season, and then the poisoned bait applied in time to destroy the flies before they can lay their eggs.

Cutworms cut off the young plants at the surface of the ground. They can be controlled by the use of poisoned bait prepared as follows:— Mix 50 lb. of wheat bran or middlings, 2 lb. of Paris green and 6 finely chopped oranges or lemons. Then add enough cheap molasses and a little water to

like a stiff dough. In the late afternoon, as cutworms feed principally at night, scatter lumps of this mixture about the size of a marble around the infested areas.

As a general rule the onion growers in northern Indiana have suffered comparatively little loss from diseases of onions. Onion mildew (*Peronospora Schleideni*) is the most serious disease and may be controlled by spraying with Bordeaux mixture.

1 - **Methods of Cultivating Trees in Relation to Soil Nitrification.** — See No. 391 of this Review.

FRUIT
GROWING

1 - **Extension of the Limits of Cultivation of the Vine By Means of Various Hybrids**

VINE GROWING.

— DANIEL, L. and TEULIÉ, H., in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 7, pp. 297-299. Paris, February 18, 1918.

One of the writers, M. L. DANIEL, had shown, in 1894 (1), that, in some cases, certain qualities could be communicated to a scion or to a subject with given defects, by grafting on improving subjects. Through this information, JURIE and CASTEL obtained noteworthy improvements in air sexual hybrids both as regards quality and resistance to phylloxera. After the death of these two hybridisers, the systematic improvement of natural hybrids of the vine was undertaken by BACO (2), who obtained in the same way sexual-asexual hybrids or graft hybrids showing considerable progress on the original hybrids. Amongst these hybrids, number 24-23, introduced by grafting, was noticeable for its earliness, and the authors began to grow it at Ille-et-Vilaine. After various trials and failures, the experiments made since 1914 appear successful and conclusive.

The BACO hybrids (mostly 24-23) of the authors' vineyard are planted under unfavourable conditions: the ground forms, between high buildings, road passage unfavourable to the concentration of heat; according to the season, the sun only reaches the plantation between 6 and 9 a. m., leaving between 3 and 6 p. m. Nevertheless, of recent years, the grapes have been ripe at the earliest on September 26 and at the latest October 18. Still better results are hoped for when the same plants are planted on the side and exposed to the heat and light from sunrise to sunset.

The wine obtained is agreeable to drink, of medium quality and richly coloured.

Formerly the vine was grown all over Brittany. Since the fourteenth century, the limits of cultivation of the vine has continually receded and recedes from north to south. With suitable plants, the former extent might be again attained, especially if cultivation were simplified, as with number 24-23, by the suppression of grafting, sulphuring and sulphating.

(1) DANIEL, L., Creation of New Varieties by Grafting (*Comptes rendus*, Vol. 118, 1894,

(2). (Authors' note).

(2) BACO, Culture directe de greffage de la vigne (*Revue Bretonne de Botanique*, 1921, Authors' note).

Analytical characteristics of the extreme harvests, 1914 and 1917.

	1914	1917	Control wine 1914 (6)
Degrees of alcohol	80	8.80	7
Dry extract	33.9	27.20	24.7
Dry vacuum extract	11	32.04	30.6
Ash	5	4.32	2.6
Sugar	5	0.96	8.6
Total acidity, in sulphuric acid	6.9	6.27	7.6
Fixed acidity	6.4	5.80	6.9
Volatile acidity	0.5	0.47	0.7
Total tartaric acidity	4.5	4.97	2.7

From experiments cited and others in progress it seems possible that the vine might be cultivated over a larger area than the present one. So an extension would obviously have considerable economic and social consequences.

425 - *Vinifera Grapes in the State of New York, U. S. A.* - ANTHONY, N. D., under direction of HEDRICK, U. P., in *New York Agricultural Experiment Station, Bulletin* No. 432, pp. 81-105. Geneva, N. Y., April, 1917.

For two hundred years vain attempts have been made to grow the European grape, *Vitis vinifera*, in eastern America. The end of these attempts was hastened by the discovery of satisfactory native sorts such as Isabe and Catawba. In the meanwhile, very different results were being seen on the Pacific coast where, in southern and central California, the *Vitis* grapes found congenial conditions.

It has been found that there were four chief reasons for the failure to grow grapes in the east: — 1) the downy and powdery mildews, 2) black rot, 3) phylloxera, and 4) winter injury.

Experimental culture of the European grape was undertaken at Geneva Station in 1900 when cuttings or plants of 19 varieties were received. In 1919 cuttings of more than 70 varieties were grafted upon a collection of Swiss seedlings ranging from 6 to 10 years old. Satisfactory results were obtained.

As a result of the work at Geneva certain recommendations can be made for New York state. One of the chief difficulties is to obtain plants of the desired kinds. Such as can be obtained are not always on resistant roots. For this reason the grower should know how to graft cuttings on phylloxera-resistant roots such as *Vitis vinifera*, which can be done either in the nursery or in the vineyard.

In planting *Vinifera*s less space is required than with the native sorts: rows 6 ft. apart and plants 6 ft. in the row give satisfactory results. In the east the vines should be supported with the regular 2-wire trellis. Because of the necessity of bending the trunk to the ground for winter protection

(1) It seemed of interest to contrast the analysis of an ordinary wine, harvested in the department of Lot, at Bétaille, right bank of the Dordogne, and made from a mixture of Lot, Canada, Othello in smallest part, and several other hybrids in very small amount. 1914 analysis was made by M. FERRIER; that of 1917 by M. C. LAURENT (*Authors' list* [424.425])

a replacing spur should be left at the base of the trunk to use in forming a new trunk when the old one becomes too stiff. The main trunk should be carried to the lower wire and 2 fruit canes and renewal spurs provided for. The young shoots that spring from these canes and spurs grow upright to the second wire, when they are pinched off and tied. This gives stockier and more mature canes for the following season. Cheap winter protection is obtained by bending the vines to the ground and covering with soil.

The chief value of the Vinifera in New York state is as a home-garden grape for the amateur, for the commercial grower supplying local markets demanding high quality, and for the plant-breeder seeking to obtain improved varieties.

Most of the Vinifera varieties have originated in regions with a longer season and a much warmer climate than that of New York and many kinds included in the tests at Geneva have been discarded because, even in the most favourable seasons, they have not reached maturity.

The varieties are classed in 4 groups: — 1) Desirable varieties for the grape regions of the State for a) the table and b) wine; 2) sorts worthy of testing in the more favourable parts of the State for a) table and b) wine; 3) kinds still on probation; 4) varieties of little or no value in the State.

After having given an historical account and discussed the work at the Geneva station, the author classifies the varieties in the following manner: —

1) *Desirable varieties for the grape regions of the State of New York.*

a) *For table use.*

Bukator
Golden Chasselas
Chasselas rose
Chasselas Besson
Féher Szagos
Kuristi Mici
Lignan Blanc
Muscat Hamburg
Early Black Muscat
Muscat Saint Laurent
Grey Pinot
Rosaki

b) *For wine.*

Blue Portuguse
Beclan
Kadarka
Mennier
Black Pinot
Pinot de Roman
White Pinot
Teinturier

2) *Varieties worth testing in the more favourable parts of the State.*

a) *For table use.*

Acton
Cinsaut
Early Frankenthal
Gradiška
Hietan
Mameion
Poulsard

b) *For wine.*

Berzemino (Marzemino)
Calmette
Grey Chanché (Chapuch)
Franken Reesling (Sylvaner)
Large Sauvignon
Slankamenka.
Syrah

3) *Varieties still on probation.*

Carignane	Oliver de Serres
Chardonnay (Chablis)	Quagliano
John Traube (Van der Laan Traube)	Savagnin Rose (Gewurztraminer)
Malaga	Red Traminer
Mammolo Toscano	Semillon
Mantua & Pils	Servan Blanc (Servant)
Monica (Cunaiolo)	Steinschiller (Rother Stielenschiller)
Muscat of Alexandria	Sultanina
Black Hungarian Muscat	Vaklepenas
Large Early Black Muscat	Zinfandel

4) *Varieties of little or no value in the State.*

Angelino	Flintendo
Aramon	Green Hungarian
Black Alicante (Black Saint Peter)	Grenache
Black Damascus	Malvasia
Black Morocco (Ribier)	Malvasia Rosario
Black Muscat (Jura Muscat)	Millennium
Cornichon Violet	Pedro Ximenes (Pedro Jimenes)
Eibling (Burger)	Schirazouli
Ferrare	White Muscat (Muscat Frontignac)
Flame Tokay	

426 - *Vine Growing in Crete.* — See No. 375 of this Review.

427 - *Winter Injury of Grapes in Kentucky, U. S. A.* — See No. 384 of this Review.

428 - *The Arboretum of M. P. de Vilmorin at Pezanin (Saône-et-Loire, France), and the Results Obtained there.* — MORRET, S., in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 5, pp. 175-186. Paris, February 6, 1918.

About fifteen years ago M. PHILIPPE DE VILMORIN established in Central France, in Charollais, at Dompierre-les-Ormes (Saône-et-Loire), a tree nursery for studying on a large scale under forest conditions, the acclimation and utilisation of the forest and ornamental trees, cultivated in his experimental grounds at Verrières (Seine-et-Oise).

The estate, called "Pézanin", is at an altitude of 1276 feet. Forty-four acres of hills are at present planted, all of which slope down to a lake covering 10 acres. The soil is granitic, composed of rock more or less worn away by exposure, the finer portions of which have accumulated in the lowest parts and form the vegetable soil. The soil is very permeable, very poor in lime and clay, and subject to drought in the sloping parts more exposed to the sun. As in many mountains, moist portions are found here and there, giving very vigorous growth. By reason of the altitude the climate is cold, and there is snow for a great part of the winter.

The first plantation was made in 1903, and planting was continued regularly in autumn every year up to 1915. Since the death of M. DE VILMORIN the experiments have been continued by M^{me} DE VILMORIN and the

author. Very interesting results have already been obtained. Over 50 000 young trees have been planted, distributed as follows:

	Trees or bushes with deciduous or persistent leaves	Conifers
species	91	32
pedes or varieties	789	206

A fairly large number of trees proved insufficiently hardy, and incapable of thriving under the harsh soil and climatic conditions; these disappeared or only live in a weak state. Unfortunately the war has not allowed complete list of these trees to be made yet. The winter 1916-17 caused the loss of many trees which had resisted till then, especially of several *Araucaria imbricata*, which froze completely.

As a rule deciduous trees did much less well at Pézanin than the conifers. Nearly all the Juglandaceae succumbed; only a few *Juglans Virginiana* managed to take hold in one part of the nursery. All the *Larix* died. The *Pterocarya* and *Juglans* which have survived have lost all their stem and are growing in bushes from the base. The *Catalpa*, *Pauhinia*, some *Acer*, *Aesculus* and *Pavia*, *Fraxinus*, *Gleditschia*, *Tilia*, many of the Leguminaceae, and various Rosaceae, are doing fairly well, usually growing from the foot instead of forming a stem.

On the other hand, certain trees, especially common acacia, birch, scruboak, and *Planera*, in particular, then oaks, willows, and alders, do more or less well, according to the species to which they belong and the place in which they are planted; the depth of the soils, which varies greatly in the different parts, naturally has much influence on their vigour. All oaks do well at Pézanin, but the rapidly growing American species, especially *Quercus coccinea*, *Q. palustris*, *Q. rubra*, *Q. tinctoria*, etc., grow as rapidly as the willows when their roots find a little depth or fissures in the underground rocks; their colours in autumn are very brilliant. Some *Quercus emata* (*Q. Daimio*), grown in a fresh position, have developed exceedingly well after having refused to grow for several years.

Some trees that are usually weakly elsewhere, particularly at Verrières, are developed surprisingly well. This is the case with: *Dirca palustris*, the curious "leatherwood" tree, whose branches are so supple that they can be rolled up like straps; with *Nothofagus antarctica*, which grows almost as vigorously as an elm, which it resembles by its foliage; *Halesia tetraetora*, the "silver-bell" tree which flowers and fruits in abundance; *Hamamelis virginica* was in flower in November 1917, at planting time; various *Rhododendron* crosses, planted in numbers in a clearing, have taken root and are growing strongly; on the contrary, *Azalea amœna* could not resist the great cold, whilst *Daphne Mezereum album* is growing well, being apparently well suited to the conditions there.

In general the conifers, which form the basis of the plantations, have done the best. Besides the forest trees common to the region, many species

cies, having found suitable surroundings there, have grown up into fine saplings. Shoots over 3 feet high are not uncommon with the Douglas fir. *Abies balsamea* has found so good a position, fresh and with a northern exposure, that some strong specimens planted in 1907 are now nearly 20 feet high.

Abies arizonica argentea, the famous "cork fir" now diffused in Europe for some 15 years, does splendidly; its thick and conical habit of growth together with its fine glaucous tint, make it one of the finest conifers in the plantation. *Abies grandis* (Vancouver fir) competes in height with the silver fir and wins by its massive branching system which spreads curiously before it begins to thicken. *Abies concolor* and *A. lasiocarpa* are in perfectly suitable surroundings, and are noticeable for their fine stature and their distinctive blue colouring. *Abies Nordmanniana*, *A. cephalonica* and several other species, do very well, even *A. Pinsapo*, a southern tree; on the contrary, however, *A. cilicica* which begins vegetation early, freezes in spring, and becomes stiff and spindle-shaped.

Several Piceas succeed at Pézanin. Besides *Picea excelsa*, grown as a forest tree, the following may be noted: — *P. pungens* (*P. Parryana*), and its very ornamental glaucous forms; *P. Morinda*, whose young shoots are liable to freeze in winter; *P. orientalis*, with its small, close, dark-green foliage, it is very distinctive and grows very well; *P. sitchensis* (*P. Menziesii*), much finer than in the Paris region, too hot and dry for it during summer. On the other hand, *P. ajanensis* does not do at all; *P. Alcockiana* which it was long mistaken, freezes in spring; and *P. Omorica*, so remarkable at Verrières, remains very poor.

The Atlas cedar and its silvery form, from which such fine colour contrasts were expected, are weakly and without any ornamental effect. The slow-growing bushy foliage of the cedar of Lebanon seems to indicate that the soil is neither sufficiently deep nor sufficiently fertile for it, while the heat is insufficient.

The common larch (*Larix europaea*) is common in the district, and its wood is in great request for its straightness and its quality, superior to that of forest pines; most of the other species do equally well there, including *Larix occidentalis*, as yet still rare in plantations, and whose branches seem more developed than those of the former. But *Larix leptolepis* is much better than the related species for the surprising rapidity of its development, which rivals that of the Douglas fir, and by its fine, straight, clear bole.

Here as elsewhere, the adaptability of the various species of pine seems much more unequal than that of the firs. *Pinus sylvestris* and *Pinus Laricio* are the commonest in the region, where they are of almost equal forest value, the latter giving more wood than the first, but of less value at any rate as a young tree. *Pinus Banksiana* and *Pinus rigida* do very well but not so well as *P. sylvestris*; they are probably preferable to the latter for dry places. *Pinus excelsa* and *P. Strobos* do equally well in Charollais but their white, soft wood, of low commercial value, hinders their wide growth. *Pinus densiflora* and *P. Thunbergii* which, in Japan, represent our

sylvestris and *P. Laricio*, are of no forestal interest for the region, for they anch and become bushy early, and their branches bend and break easily der snow. *Pinus ponderosa* and its varieties are weakly and its shoots are acked by *Tortyx buoliana* as is the case in many places. Most of the er pines do not grow very well, and are only of interest in a collection.

3 - "Peh-Muh" and "Xun-Peh-Muh", Trees in Tonkin New to Science. — BUNGO-HAYATA, in *Bulletin économique de l'Indochine*, Year XX, New Series, No. 126, pp. 435-440 + 1 Plate of 14 Figs. Hanoi-Haiphong, September-October, 1917.

The author's attention was drawn to a Chinese poem, the "Shu-hai" (Song of Great Forests) of CHAO-OU-PEI, who pictures an immense est composed of trees, the description of which shows them to be Coniferae, resembling the genus *Cupressus*. The author came to the conclusion at these trees were only to be found in the mountainous districts bordering Yunnan and Tonkin, and came to Chapa (Tonkin) to study them on the ot. They belong to two species, known locally as "Peh-Muh" and Xun-Peh-Muh".

The conifer "Peh-Muh" is a species of new genus, *Fokienia*, formed in 11 by Messrs. A. HENRY and THOMAS. The author calls this species *Fokienia Kawaii* Hay, and gives a description of it in Latin.

The conifer "Xun-Peh-Muh" appears to be a new species of the genus *Podocarpus* and belongs to the small section *Podocarpus*. The author proposes to call it *Podocarpus Kawaii* Hay, and describes it in Latin.

The forests formed by these two species are found over a considerable a in the mountain district (Chapa is at an altitude of 4 920 feet) and have er been cut (1).

1 - The Forests of the Island of Cyprus. — See No. 376 of this Review.

1 - Fertility and Population of the Sandy Pine Plains of Northern Wisconsin. — See No. 385 of this Review.

LIVE STOCK AND BREEDING.

1 - Experimental Feeding of Sheep with Two Poison Plants: Wild Indigo (*Swainsona luteola*) and Native Wild Tobacco (*Nicotiana suaveolens*) in New South Wales. — CLELAND, J. B. and Mc DONALD, A. H. E., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 10, pp. 735-739. Sydney, October, 1917.

The injurious effects on sheep caused by eating certain species of *Swainsona*, usually called Darling Pea, have long been known. The species really concerned are *S. galegifolia* and *S. Greyana*; *S. lassertifolia* in nder's Island, Bass Strait, and *S. procumbens* or Broughton Pea, in South stralia are also suspected. Up to the present, analysis has not shown e presence of any poisonous substance in these plants.

11. With regard to the wood and its possible use the author refers the reader to the *Bulletin économique de l'Indochine*, New Series, No. 98, p. 708, Sept.-Oct. 1912, "Coffin Woods the Hà-giang District", by BONIFACE, and No. 100, p. 106, Jan.-Feb. 1913, "Further as on Coffin Woods", by BONIFACE and CH. LEMURIE, in which the authors discuss the 11ers of the north of Tonkin ("peu mou", "cha mou", etc.), the wood of which is 11ly used by the Chinese for making their coffins (E.L.).

HYGIENE

The *Agricultural Gazette of New South Wales* has published papers on this subject. The most important experimental results were those contributed in 1897 by Dr. C. J. MARTIN from experiments in which six sheep were fed exclusively on *S. galegifolia*, salt and water. He observed the following symptoms (nervous disorders, anaemia), attributed by herdsmen to feeding on this plant. In adult sheep definite symptoms started when the animals had eaten the plant for 3 to 4 weeks. Under the experimental conditions the sheep lived for about 3 months, but were very weak. Animals which received normal fodder after being fed on *S. galegifolia* for 4 to 6 weeks and before the symptoms of poisoning were fully established, recovered completely. If, however, paralytic symptoms had already occurred, return to normal food did not cure, but only prevented the animal from becoming worse.

The poison in *S. galegifolia*, if there be any, is, therefore, weak and cumulative, or possibly it may cause a "deficiency disease". If this second hypothesis be true completing the ration by foods rich in vitamins would be sufficient to prevent the disease. In the experiments described brewers' yeast was used as a supplement. The results were not conclusive, but seemed to show that the disease is not a deficiency one. The experiments were made with *S. luteola*, locally called "indigo", at the Coonamble Experiment Farm. Two sheep fed exclusively on 9 lb. per head daily of this plant became ill; two other subjects which, besides the same ration of *S. luteola*, also received $\frac{1}{2}$ pint of brewers' yeast per day, also became ill. The experiment was started on September 1. The first symptoms occurred on October 11, a few days after the plants fed had begun to fructify. Feeding with indigo was stopped on October 27 and normal food supplied. One of the sheep fed exclusively on indigo died; the other of the same group and the two which had also received yeast, improved, and were still alive on March 20, though they had the peculiar appearance known as "crazed".

The same, or a similar, disease is known in America, where it is called "Loco disease"; it is caused especially by *Astragalus mollissimus* and *Oxytropis Lambertii*.

Native wild tobacco (*Nicotiana suaveolens*) has long been suspected to be poisonous. It undoubtedly contains active principles capable of causing serious and, perhaps, fatal results if eaten in sufficiently large quantities. An experiment was started on September 25 at the Coonamble Experiment Station to determine whether, under natural conditions, sheep can eat a sufficient quantity of it to cause ill effects. The sheep showed a strong antipathy to the tobacco, and would only accept it chopped up with wheat chaff; they ate, on the average, 1 $\frac{1}{2}$ lb. per head daily. Ten animals given this ration till November 27 showed no signs of illness. The experimental amount of this plant seems, therefore, to be harmless.

433 - Parasitic Nematodes in the Belgian Congo. — RAILLET, A. and HENRY, A., in *Bulletin de la Société de Pathologie exotique*, Year XI, No. 2, pp. 82-86, Paris, February 1918.

A collection brought from the Belgian Congo by M. VAN SAGEGHEM and studied by him in the Parasitology Laboratory at Alfort, and another brought

[432-433]

gether between 1907 to 1910 at the Leopoldville Laboratory by MM. RODEN and RODHAIN, have been used by the writers to make up the following list:—

I. — Fam. STRONGYLIDÆ: A) Sub-fam. ŒSOPHAGASTOMINÆ: *Œsophagostomum* sp. (gut of a black monkey); *Œs. columbianum* (intestine of sheep and goats); *Œs. radiatum* (intestine of cattle).

B) Sub-fam. STRONGYLINÆ: *Strongylus equinus* (intestine of horse); *Angiostrongylus duodenale* (man); *A. caninum* (dog).

C) Sub-fam. BUNOSTOMINÆ: *Bunostomum trigonocephalum* (intestine of goat); *B. phlebotomum* (intestine of calves); *Necator americanus* (intestine of man); *Gaigeria pachysealis* (intestine of sheep); *Stephanurus dentatus* (body cavity of porker).

II. — Fam. TRICHOSTRONGYLIDÆ: *Haemonchus contortus* (intestine of cow, sheep, goat); *Trichostrongylus colubriformis* (intestine of sheep, goat).

III. — Fam. METASTRONGYLIDÆ: *Megastrongylus elongatus* (bronchi of pig); *Dictyocaulus* sp. (bronchi of monkey *Macacus*).

IV. — Fam. ASCARIDÆ: Sub-fam. ASCARINÆ: *Belascaris marginata* (intestine of dog).

V. — Fam. OXYURIDÆ: Sub-fam. OXYURINÆ: *Oxyuris equi* (form mastitis) (intestine of horse).

VI. — Fam. HETERAKIDÆ: Sub-fam. HETERAKINÆ: *Ascaridia persipim* (intestine of fowls and pullets); Sub-fam. SUBULURINÆ: *Subulurans* (intestine of monkey).

VII. — Fam. SPIRURIDÆ: A) Sub-fam. SPIRURINÆ: *Habronema macrostomum* (stomach of a mule imported from Teneriffe).

B) Sub-fam. GONGYLOSTEMINÆ: *Gongylostoma verrucosum* (mucosa of a pig's stomach).

C) Sub-fam. ARDUEININÆ: *Streptopharagus pigmentatus* (intestine of a monkey).

VIII. — Fam. THELAZIIDÆ: *Oxyuris mansonii* (conjunctival cul-de-sac of fowls).

IX. — Fam. ACUARIIDÆ: Sub-fam. PHYSALOPTERINÆ: *Physaloptera leucata*? (stomach of an iguana).

X. — Fam. DRACUNCULIDÆ: *Dracunculus dahomensis* (conjunctive sac of a python).

XI. — Fam. FILARIIDÆ: *Loa loa* (man); *Dirofilaria corynodes* (subconjunctive tissue of monkey); *Setaria labiato-papillosa* (body of peritoneal cavities of cattle); *S. equina* (peritoneal cavity of horse).

XII. — Fam. TRICHRIDÆ: Sub-fam. TRICHRINÆ: *Trichuris ovis* (intestine of a goat).

In M. VAN SAGEGHIEN's collection there are also: some nematodes from the animals, still being studied, and also an *Evansia* and *Murshidia* of the African elephant; an acanthocephalus, *Gigantorhynchus hirundinaceus*, the intestine of the pig and a trematode, *Gastrodiscus acgyptiacus*, from the intestine of the horse.

- 434 - **The Culture of the Parasite of Epizootic Lymphangitis and the Experimental Production of the Disease in the Horse, in France.** — BOGUET, A. and NÉGRAT, L., in *Comptes rendus des Séances de l'Académie des Sciences*, Year CLXVI, No. 7, pp. 308-311, Paris, February 18, 1918.

Epizootic lymphangitis ("African farcy") is caused by a specific parasite discovered by RIVOLTA and placed by him in the Blastomycetes, *Cryptococcus farciniosus*. In spite of the researches of TOKISHIGE, MARCON and SANFELICE the nature of the parasite was still doubted since, late, certain authors considered it to be a protozoon.

The authors have shown, by their researches, the nature of RIVOLTA's cryptococcus by the growth of the parasite as mycelium in cultures which could be propagated and by the experimental production of the disease by inoculating these cultures into the horse. The experiments are fully described. Further work on vaccination and bacteriotherapy by means of heated cultures is in progress.

- 435 - **Immunisation of Goats against Malta Fever by Vaccination.** — See No. 39; this Review.

- 436 - **Contagious Septicaemia of Swine in Morocco.** — VEU, H. (Laboratoire de Recherches du Service de l'Élevage du Maroc), in the *Bulletin de la Société de Pathologie exotique*, Year XI, No. 2, pp. 117-124, Paris, February 13, 1918.

Clinical observations have shown that, in Morocco, there exists a contagious disease of swine, which chiefly attacks young or middle-aged subjects, and is characterised by lesions resembling those of septicaemia (pulmonary hepatisation, tumefaction and haemorrhagic infiltration of the lymphatic ganglia, congestion and haemorrhagic foci on the skin and serous membranes, but without lesions of croup or diphtheria).

An ovoid bacterium, which is probably *Pasteurella*, was found to be almost always present in the bronchial ganglia, pulmonary lesions, and exsudates.

Experimental study has shown that: — 1) this ovoid bacterium is clearly pathogenic for the pig and, on inoculation it reproduces the disease; 2) contamination is carried out by faecal matter; 3) infection takes place through the digestive or respiratory channel.

CONCLUSIONS. — Severe epizootics of swine, with varying symptoms and which flourish in certain piggeries of Chaouia, seem exclusively due to *Pasteurella*, the presence of which can easily be shown in all the sick animals. The confirmation of these facts by further research would be of great importance. These simple infections could then be combated under good conditions, by means of the usual processes of vaccination, serotherapy, bacteriotherapy.

- 437 - **Avian Blood Parasites of French Guiana.** — LEGER, MARCEL (Institut d'Hygiène Cayenne), in the *Bulletin de la Société de Pathologie exotique*, Year XI, No. 2, pp. 125-126, Paris, February 13, 1918.

I. — **TRYPANOSOMES:** — *Trypanosoma ardeae* n. sp., parasite of *Nyctanassa violacea*; *T. ardeae* var. *major* n. var., parasite of *Ordea cinctus*; *Trypanosoma* sp., parasite of *Butorides striata*.

II. — **HAEMOPROTEUS** : — six undetermined species of *Haemoproteus* parasites respectively of *Falco sparverius*, *Anas moschata*, *Tringa atricapilla*, domestic pigeon, *Columba rustina*, *Scops brasiliana*.

III. — **MICROFILARIAE** : — six undetermined species respectively parasites of *Nyctanassa violacea*, *Rallus longirostris*, *Crypturus cinereus*, *Platysticus phaeopygus*, *Ardea coerulescens*.

IV. **SPIROCHAETAE** : — *Spirochaeta gallinarum*, the cause of disastrous pizooties, devastating whole roosts, and appearing, so it seems, every 4 or 5 years. Fowl spirochaetosis had not previously been identified in Guiana. The pathogenic agent was discovered in Martinique by SIMOND, AUBERT and LOC in 1909 and in Brazil by MARCHOUX and SALIMBENT in 1913.

The author observes that : — 1) according to his observations haematocrits are less common in birds in Guiana than in Tonkin, French Soudan, and even in France (Corsica and Reims region) ; 2) he has never found a *Leucocytozoon* during examination of more than 500 birds, belonging to 8 species of 27 families ; and as the numerous haematological researches of BRIMONT in Guiana, CARINI and collaborators in Brazil, and ITURBE and GONZALES in Venezuela have also always given negative results as regards this, it seems doubtful if the genus *Leucocytozoon* is really represented in South America.

38 - **Chicken-pox in Poultry, in Canada.** — UPTON, H. E., in *Province of British Columbia, Department of Agriculture, Live Stock Branch, Poultry Division, Circular Bulletin No. 20*, pp. 5, Figs. 5. Victoria, 1917.

Chicken pox is usually accompanied by other diseases such as diphtheric roup, canker, and swollen head. As long as the affection stays on the skin of the head very little trouble is caused.

SYMPTOMS. — The disease shown itself in 2 forms : — 1) Chicken pox (*Epidemioma contagiosum*), causing nodules and ulcers on the head, especially in parts not well feathered ; 2) small diphtheric patches appearing in and round the mouth, on the tongue, and at the mouth of the windpipe ; if the disease is allowed to develop, the fowl will be prevented from either eating or breathing. The patches also appear on the side of the face ; they may reach the eyes and cause blindness.

PREVENTIVE MEASURES. — The poultry house should be disinfected and kept clean ; the poultry runs, the hands and shoes of those handling the stock, should be also disinfected and cleaned. Diseased birds should be isolated and dead birds burned. Prevent pigeons and other birds from walking on contaminated ground and thus spreading the disease. An excellent germicide to use in the drinking-water can be prepared by quickly stirring 2 oz. oil of sassafras into 2 gallons water ; pour and mix slowly 2 fluid ounces sulphuric acid in this mixture ; to use, add one table-spoonful of the mixture to each gallon of drinkingwater.

TREATMENT. — The fowls should be kept housed during the winter, and the runs covered with quicklime. Change the straw and litter in the houses, burn the dirty straw and disinfect the roosts and drop boards with carbolic acid.

The Poultry Division of the Department of Agriculture of British Columbia have carried out experiments in an endeavour to cure and prevent the disease by vaccination. The writer vaccinated about 3 000 birds ranging from five weeks to three years in age. Control birds were left in each flock 40 % died. Some flocks were vaccinated with vaccine made from scabs only; others with vaccine made from scabs and cheesy exudate, or from scabs and exudate mixed together then attenuated, or attenuated separately then mixed. The best results were obtained with the vaccine prepared from scabs and exudate ground together then attenuated. With 5- to 8-week old chicks (the majority showing signs of disease after severe chilling), good results were obtained by injecting $\frac{1}{2}$ cc. of vaccine twice at an interval of 3 to 4 days. In some very bad cases, expected to die, 2 cc. were injected and complete recovery obtained. No bad effects were noticed, though 3 birds died owing to emaciation before the injection. Egg production was not affected in any way.

The scabs and exudate should be removed with a sterile pair of scissors and tincture of iodine applied to the exposed surface.

The method of preparing the vaccine is as follows: — One half gram of chicken pox scabs and exudate are ground in a sterile mortar with 100 cc of physiological salt solution. This material is poured in a flask, stoppered, placed in a water bath, and attenuated at 55° C. for one hour. Filter into a sterile flask and wash the filter with the rest of the salt solution. It is essential that the vaccine be used as soon after preparation as possible, as it will deteriorate and give poor results.

439 - **The Chemical Composition of the Placenta of the Cow.** — FENGER, F. (Research Laboratory in Organotherapeutics of Armour and Company, Chicago), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 1, pp. 19-23. Baltimore, Md., February, 1917.

The constituents of the uterine placenta seem to remain comparatively uniform throughout gestation, while the foetal placenta varies considerably in composition at different stages of pregnancy. This is well shown by the results obtained by the author and summarized in the appended table. The results show that the maternal cotyledons contain less moisture and more protein and fats, phosphatides, etc., than their corresponding placentulas. The older uterine cotyledons contain more potassium and less sodium than the younger, but otherwise the variations in the mineral constituent are comparatively slight at the two selected stages of pregnancy. The young foetal placenta contains much more chlorine and considerably more sodium and calcium and less of the other inorganic constituents than the older foetal placenta. It is evident, therefore, that chlorine, sodium and calcium are of vital importance in early foetal life. Later, during the rapid growth periods, the amounts of these three elements diminish while the quantities of phosphorus, sulphur, potassium, iron, and magnesia increase. The 3 to 4 months old foetal placentulas, which are of a pale pink colour, contain only about $\frac{1}{3}$ the quantity of iron that is present in the older and dark red foetal placentulas. This indicates that the amount of haemoglobin in the foetal blood is small during the earlier stages of pregnancy, but in

cases in direct proportion to the growth of the foetus. All the samples examined by the author gave negative tests for epinephrin and iodine.

Composition of the foetal placenta at various phases of gestation.

	Maternal placentulas (uterine cotyledons) of 3-4 months	Maternal placentulas (uterine cotyledons) of 7-9 months	Foetal placentulas (foetal cotyledons) of 3-4 months	Foetal placentulas (foetal cotyledons) of 7-9 months
<i>Fresh tissue:</i>				
average weight gm.	13.6	39.6	10.4	27.6
moisture %	83.20	82.00	88.40	84.20
iodine ether-soluble substances . . . %	1.45 *	1.48 *	0.69 **	0.84 **
γ_2 in petroleum ether-soluble substances %	2.10	2.22	2.50	1.51
phosphatides (lecithin) in fresh tissue . %	0.34	0.37	0.19	0.14
decolorized fat-free material %	15.35	16.52	10.91	14.96
<i>Isolated fat-free material:</i>				
moisture %	5.55	4.45	7.05	5.05
protein %	0.50	0.38	10.25	0.93
total nitrogen %	13.17	13.41	12.03	13.18
protein (N \times 6.25) %	82.30	83.81	75.19	82.37
phosphoric acid (P_2O_5) %	3.95	3.77	3.92	3.65
phosphoric acid (SO_4) %	1.85	1.79	1.56	1.62
chlorine (Cl) %	0.17	0.15	2.66	0.49
potassium (K) %	1.51	1.71	1.87	1.44
sodium (Na) %	0.85	0.71	1.73	0.96
iron (Fe) %	0.014	0.02	0.028	0.063
calcium (Ca) %	0.179	0.179	0.157	0.159
magnesium (Mg) %	0.115	0.127	0.109	0.120

* Yellow, semisolid, lecithin odour.

** Dark orange, semisolid, lecithin odour.

- Foetal Athyrosis: A Study of the Iodine Requirement of the Pregnant Sow. —

SMITH, FENNIS, G. (Montana Experiment Station, University of Montana, Bozeman), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 2, pp. 215-225, 3 Tables. Baltimore, March, 1917.

The paper describes an investigation into hairlessness and enlarged thyroid glands, found, in certain parts of Montana, among sows, sheep, and mares (1).

The author obtained the following results experimentally: —

An iodine deficiency during the gestation period causes a lack of function and hyperplasia of the foetal thyroid, causing arrested development of the foetus. If more iodine were fed to the pregnant animals in many parts of the United States, their young would be more healthy and vigorous. Foetal athyrosis shows that there is a direct relation between the physiologically active constituents of the thyroid and growth of the epidermal appendages. An abundant secretion of the foetal thyroid during the later stages of the intra-uterine life is essential to the normal development of the foetus.

(1) See R. March, 1918, No. 305. (Ed.)

441—The Availability of the Energy of Food for Growth.—Moulton, C. R., in *The Journal of Biological Chemistry*, Vol. XXXI, No. 2, pp. 389-394, 3 Tables. Baltimore, August, 1917.

Experiments on the use of food have been conducted at the University of Missouri Agricultural Experiment Station, and some data have been obtained upon the relative amount of the energy of the food which may be recovered in flesh gained. The animals used were mature beef steers, 2 or 3 years old, of the Shorthorn breed; they were as alike in weight, previous method of treatment and type as is possible. The ration consisted of 5 parts of mixed grain (8 parts of maize meal and 1 of cold-pressed linseed meal) to 2 of alfalfa hay.

The digestibility of the ration was determined by digestion trials. The cost of maintaining the animals at constant weight was determined by extended maintenance trials. After the maintenance trial steer 18 was slaughtered for analysis; the other 2 were fattened, steer 48 to prime condition, steer 121 to a condition of 40 to 50 days under prime; they were then slaughtered and analysed. Table I shows the composition of the gain of weight. In calculating the thermic equivalent of the fat and protein, the value of 5.6776 calories per gm. was used for the protein, and 9.4886 for the fat. The equivalent metabolizable energy for the ration was found by ARMSBY's method (1) to be 3 803 calories per kg. of digestible organic matter. The data are given in Table II.

The metabolizable energy that may be used for production of flesh is that amount over and above the needs for maintenance. Using the average weight of the animal while on maintenance and the maintenance cost found by trial for each, the cost of maintenance during the full feed period was calculated. The amounts of energy required for maintenance at different body weights are proportional to the body surfaces, *i. e.*, roughly to the two-thirds power of the body weights. In previous work (*J. Biol. Chem.* 1916, XXIV, 299) the author has shown that the surface area of a thin or medium fleshed steer is more nearly proportional to the $\frac{5}{8}$ power of the weight, while with very fat steers the $\frac{5}{8}$ power should be used. Both the $\frac{5}{8}$ power and the $\frac{2}{3}$ power were used in the calculations (the latter is used in Table II) and a difference of 0.25 % of the net energy cost (2) a

(1) See *B. June*, 1915, No. 625 (*Ed.*).

(2) Food which enters the animal body has a certain amount of total energy, called the heat of combustion. This energy is different for different feeds. Of this total energy the animal loses part by way of the faeces in the undigested food residues, part by way of the urine in incompletely oxidized bodies, and part by way of combustible bodies voided. The amount over and above these losses is called the metabolizable energy. Not all of this metabolizable energy is available for the use of the animal body in either maintenance or growth. There is a loss due to the work of digestion, mastication, and movement of the food through the digestive tract. There is also a further loss due to a stimulated metabolism upon the absorption of digestible substances from the alimentary tract. There may be a slightly greater muscular activity due to the increased food consumed. All this energy is converted into heat and lost from the body. What is left of the metabolizable energy after these second losses are accounted for is called the net, or available, energy. This may be used for production of work, or may be stored in the animal body in the form of protein, fats or other body substances (*Auth.*)

pound of gain for Steer 18 and 1.5 % for Steer 48 was found. The true value would lie between that given in Table II and a value smaller by the above percentage amounts. The error could therefore be hardly more than half that shown, or about 0.75 % of the total for Steer 48. The error in the calculation of the per cent. of available energy would be about double this error. The error is so small that a more complex method of calculation is not required.

TABLE I. — *Composition of Gain. Energy Stored in Flesh Gained.*

	Steer 121		Steer 48	
	Flesh gained	Composition	Flesh gained	Composition
	(estimated)	of gain	(estimated)	of gain
	gm.	per cent.	gm.	per cent.
Warm empty weight	211 726	—	417 900	—
Water	84 174	39.76	123 372	29.52
Total	97 626	46.11	218 246	59.49
Protein	3 981	1.88	5 707	1.37
Starch	24 879	11.75	35 067	8.54
Lipids	4 161	1.97	7 084	1.70
Phosphorus	597	0.28	1 155	0.28
Energy in fat, calories	926 359	—	2 355 601	—
Energy in protein	141 252	—	202 502	—
Total energy stored	1 067 611	—	2 558 103	—

TABLE II. — *Gross and Net Cost of Gain.
Per Cent Availability of Energy.*

		Steer 121	Steer 48
Length of period	days	153	567
Weight at beginning	lb.	764	842
Weight at end	"	1 266	1 805
Weight gained	"	502	963
Feed eaten daily	"	18.34	16.93
Feed cost	"	7.21	7.01
Gross nutrients	"	3 308	11 321
Available organic nutrients	"	2 267	7 800
Available energy	therms	3 900	13 519
Energy per lb. gain	"	7.73	14.03
Live weight of animal	lb.	1 041	1 384
Energy per 1000 lb. for maintenance	therms	12.14	12.73
Total energy for maintenance	"	1 900	8 646
Energy above maintenance	"	2 000	4 873
Energy above maintenance per lb. of gain	"	3.98	5.06
Energy recovered in gain	"	1 067.6	2 558.1
Available energy recovered	%	53.39	52.49

The results of the calculations, given in Table II, show a much higher productive energy cost of each pound of gain for the very fat steer than for the medium fat steer. Steer 48 gained about 29 % more fat than Steer 121 the productive energy increased in about the same proportion (27 %).

In the tissues gained by these animals, one recovered 53.39 % of the metabolizable energy consumed above maintenance and the other recovered 52.94 %. Thus it is seen that the energy saved was about the same in both animals. Since this proportion of the energy is recovered it may be said that this is a measure of the availability and that the metabolizable energy of the ration used was 52.94 % available, or net.

Using the data given by ARMSBY (*loc. cit.*) the author has calculated that 54.995 % of the metabolizable energy was available, which agrees very closely with ARMSBY's figure (55 %).

442—**The Feeding of Young Chicks on Grain Mixtures of High and Low Lysine Content** (1). — BUCKNER, G. D., NOLLAU, E. H. and KASTLE, J. H., in *Kentucky Agricultural Experiment Station, Bulletin* No. 197, pp. 21, Tables IV, 16 Photographs.

It has been shown by OSBORNE and MENDEL in an exhaustive series of experiments on the feeding of albino rats, that lysine is primarily responsible for the stimulation of growth. The authors undertook a series of experiments regarding this subject on feeding young chicks using grain mixtures containing a low and high lysine content respectively.

EXPERIMENT I. — Two lots of young chicks of mixed breed were chosen. At the beginning of the experiment the weight in Lot I (10 chicks) was 438 gm., or an average of 43.8 gm. per chick, and in Lot II (9 chicks) 338 gm. or an average of 43.1 gm. per chick. The experiment lasted 8 weeks (May 13 to July 6, 1915) and the two lots were fed as follows:

Lot I. — received a mash twice a day, morning and evening, consisting of equal parts by weight of finely ground wheat, wheat bran, sunflower seed and hemp seed, moistened with skim milk; and once a day at noon they were given a coarsely ground mixture of wheat, hemp seed and cracked maize.

Lot II. — received 30 gm. of a mash consisting of finely ground barley, rice, hominy and oats, 100 gm. each and 56 gm. of gluten flour, the mash being made with protein-free milk; at noon they received from 30 to 50 gm. of a mixture of equal parts of barley, rice and hominy.

On hydrolysis, these various rations gave (by the VAN SLIKE method) the following figures for the lysine content: —

Lot I		Lot II	
Mash	Grain mixture	Mash	Grain mixture
3.80 %	2.23 %	0.50 %	0.79 %

RESULTS. — The chickens were weighed regularly every 6 days. At the end of the experiment 5 average chickens of Lot I weighed 2 553 gm.,

(1) See *R.*, February 1918, No. 186 (*Ed.*).

chick in Lot II weighed 1195 gm. The average increase in weight was 98 gm. for Lot I and only 15.6 gm. for Lot II. This striking difference is shown clearly by photographs, which also show the state of development and feathering. Further, the chickens of Lot I were much more active than those of Lot II.

At the end of the experiment (July 6), the chickens of Lot II were put on the rations fed to Lot I. On July 13, the chickens of Lot II gained weight 344 gm. or an increase in 7 days of 41.2 gm. per chick (the previous average, before exchange of the rations, was 15.9 gm.).

These results show that while the chickens of Lot I grew normally, those of Lot II were stunted in their growth. This difference in nutrition probably due to the difference in the amount of lysine received by the lots and possibly to a difference in the quantity and nature of the fats in the rations. The content in fats was as follows: —

Lot I		Lot II	
Mash	Grain mixture	Mash	Grain mixture
13.8 %	8.21 %	1.8 %	1.0 %

It should be remembered that OSBORNE and MENDEL and other investigators have shown that certain of the natural fats contain substances which stimulate animal growth (1). Such fats are found in butter, cod liver oil, yolk of egg, etc.; many grains and vegetable products probably also contain growth-promoting fats. For this reason it is not safe to explain the better growth of Lot I by the better quality of the protein in the ration. It thus remains to be determined whether the difference is due to differences in the protein or fats, one or both. To throw light on this question, the following experiment was carried out.

EXPERIMENT II. — Two lots of 48 White Leghorn chicks, Lots III and IV, were given the same rations as Lots I and II, save that to the ration given to Lot IV there was added sufficient butter fat to bring up the fat content up to that of the ration fed to Lot III (the old Lot I). The initial weight of Lot III (12 chicks) was 488 gm., or an average of 40.6 gm. per chick. Lot IV weighed 471 gm., or an average of 39.25 gm. per chick. After 8 weeks, each chick of Lot III weighed on an average 395.6 gm., while in Lot IV, each chick weighed an average of 118 gm. Thus Lot III showed an average gain per chick of 277.6 gm. over the chicks of Lot IV. Differences in development, health, plumage, etc., were again clearly marked, and although the chicks of Lot IV were quite healthy, their growth was obviously stunted.

At the end of the second experiment the rations were again reversed, with striking results: after 3 weeks, Lot III made a percentage gain of

(1) See *R.*, February 1918, No. 182 (*Ed.*).

5.1 as against 28.9 for Lot IV. Within one week after reversing the ration the external sexual characteristics of the chicks of Lot IV became noticeable and after the third week were very pronounced.

CONCLUSION. — It is evident that the marked differences shown by the two lots in rate of growth cannot be ascribed to the fat content of the 2 rations, but rather to differences in the amino-acid content of the ration and particularly to differences in the lysine content.

The writers emphasise the value of feeding experiments with the chicks both from a practical and a scientific standpoint. The financial return from a sound method of feeding chickens would be enormous. From purely scientific standpoint the young chicken is very suitable for feeding experiments as it reaches maturity in so short a time.

443 — **The Relative Value of Certain Proteins and Protein Concentrates as Supplements to Maize Gluten.** — OSBORNE, T. B. and MENDEL, L. B. with the Cooperation of FARR, E. L. and WAKEMAN, A. J. (Laboratory of the Connecticut Agricultural Experiment Station and the Sheffield Laboratory of Physiological Chemistry in Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 1, pp. 69-92, 8 Tables and 1 Chart. Baltimore, February, 1917.

The writers undertook to measure the comparative nutritive potency of different proteins or protein concentrates. The experiments were made with rats. With inadequate maize gluten as the basis of the nitrogenous part of the ration, the following substances were added to the diet: — casein; lactalbumin; edestin (prepared by extracting ground hemp seed with sodium chloride, repeated solution and precipitation by dilution and cooling); cottonseed protein; cottonseed flour (43.7 % protein); milkalbumin; commercial product containing 54.2 % protein and 23.8 % of ash; beef tissue (made by drying the residue left after thoroughly extracting fresh chopped beef with water); fish meal meal (herrings, 60.5 % protein); maize germ cake (17.5 % protein); vegetable albumin flour (a commercial product, with 74.7 % protein, presumably consisting of the residues from the manufacture of wheat starch); brewers' grains (45 % protein); distillers' grains (29.4 % protein); pea meal (26.5 % protein); peanut meal (after extraction of oil; 29.4 % protein). It was found that these food mixtures, of approximately the same nitrogen and calorific content, vary greatly in their efficiency for promoting growth, in accordance with both their character and the proportion of the protein supplement employed. The efficiency of these supplements presumably depends essentially on their relative content in lysine and tryptophane; for the addition of these amino acids, either as such, or in the form of proteins yielding them, rendered maize gluten suitable for growth.

Of the various proteins employed to supplement the inefficient maize gluten, lactalbumin is by far the most effective. Satisfactory growth is obtained with smaller quantities of this protein than of any of the others recorded. The brewers' grains, distillers' grains, and "vegetable albumin flour" were the least efficient supplements used, presumably because of the low lysine content.

It is evident that the small additions of the more efficient proteins a

ally supplement the maize gluten instead of themselves furnishing all the protein used for growth, because equivalent amounts of these proteins alone at a similar ration are incapable of inducing a comparable degree of growth.

Small amounts of a superior protein are often quite as efficient for growth as larger amounts of a less adequate protein.

The Nutritive Properties of Kafirin. — HOGAN, A. G. (Department of Chemistry, Kansas State Agricultural Experiment Station, Manhattan), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 1, pp. 151-159, 4 Charts. Baltimore, January, 1918.

JOHNS and BREWSTER (1) have shown that most of the nitrogenous part of kafir (the north American variety of sorghum), about 67 per cent. of total protein, is soluble in alcohol, and they called this particular protein "kafirin". This protein contains 55.19 % of carbon, 7.36 % of hydrogen, 16.44 % of nitrogen, 0.60 % of sulphur and 20.41 % of oxygen. It contains the following diamino-acids:— arginine, 1.58 %; lysine, 0.90 %; histidine, 1.00 %; and tryptophane, present.

Because kafirin forms such a large proportion of the protein of kafir, and because of its increased economic importance for growth in regions of hot and insufficient rainfall, its nutritive properties were studied in detail.

A basal ration was prepared containing protein, protein-free milk, butyrum, starch, agar, and in which kafirin formed practically the only source of protein. This diet was given to rats and always resulted in nutritive failure, accordingly kafirin was supplemented with other deficient proteins, gliadin (10 % of the basal ration) and gelatine (10 % of the basal ration) or both proteins together (5 % of each). The addition of gliadin, for a short time at least, barely sufficed to maintain the live weight of the animals; but the addition of gelatine enabled them to grow slowly, while the two proteins together produced more rapid growth than gelatine alone. It thus seems that there are at least two limiting factors in gliadin as a source of protein; gelatine supplies one (lysine) and gliadin the other (cystine).

In further experiments the following amino-acids were added to the basal ration:— tyrosine, cystine, tryptophane and lysine, either separately or mixed individually with lysine. It was found that the addition of tryptophane and tyrosine did not increase the rate of growth of the rats; on the contrary, however, the addition of lysine plus cystine produced a marked increase of growth. The author concludes that the limiting factors in kafirin are lysine and cystine. In addition, the data obtained show that lysine is indispensable for the maintenance of young animals. BOBNE and MENDEL (1914) were of the opinion that lysine is necessary for growth but not for maintenance, because rats receiving gliadin as the sole source of protein in their ration maintained their live weight unchanged, but failed to grow, and because it was then thought that gliadin contained no lysine. The method of VAN SLIKE showed that gliadin contained an average of 1.33 % of lysine. Kafirin contains 0.90 % of lysine, but it seems that lysine is completely wanting in zein.

(1) See R., February 1917, No. 126. (Ed.)

- 445 - **The Influence of the Stage of Gestation on the Composition and Properties of Milk.** — PALMER, L. S. and ECKLES, C. H., in the *Journal of Dairy Science*, Vol. 1, No. 3, pp. 185-198. Baltimore, September, 1917.

The question of the influence which is exerted by gestation on the composition of cows' milk has received practically no attention from an experimental point of view. This paper presents data bearing on this question consisting in complete analyses of the milk and milk fat throughout the entire lactation period of ten cows which became pregnant at various stages of their lactation period, of one cow which was farrow and the complete analyses of the milk for three of the ten cows throughout a subsequent lactation when they were kept farrow.

It is well known that the percentage composition of cows' milk and the constitution of the milk fat, as shown by physical and chemical constants, undergo certain definite changes as the stage of lactation progresses. These changes are usually particularly marked at the close of lactation. Since under normal conditions, nearly all cows are bred at some stage of their lactation period, it is difficult to determine how much the stage of pregnancy or the stage of gestation contribute to these changes in the composition of the milk and milk fat.

The completeness of the data for the lactation periods of the experimental animals has made it possible to compare the composition of the milk and the milk fat at any stage of lactation with the average composition for the entire period. Inasmuch as the date of breeding of the animals occurred at different stages of lactation for each of the animals it has been possible to ascertain at what stage of lactation the composition of the milk and milk fat for each animal showed permanent changes from the average, and to note, at the same time, at what stage of gestation these changes took place. It seemed probable that there should be some uniformity among the different animals with regard to the stage of duration of the factor contributing the strongest influence upon the composition of the milk. Tabulation of the results from this standpoint revealed the fact, that permanent changes from the average composition of the fat occurred several weeks sooner, on the average, than similar changes in the percentage composition of the milk.

An examination of the data on the average composition of the milk for the entire lactation period in comparison with the composition of the seven-day composite which showed the first permanent change from the average, and the stages of lactation and gestation when this change occurred, shows a close relation existing between a change in the percentage composition of the milk and the stage of the lactation period, particularly with respect to the relative stage of lactation.

The data fail to reveal, however, that the changes in the composition of the milk bore any constant relation to the stage of gestation. Similar results are obtained on examination of similar data for the physical and chemical constants of the milk fat. Although the relations between the changes in the constitution of the milk fat and the stage of lactation is much less constant, the same result holds true with respect to the relation to the stage of

estation. It would appear that some other factor may have been partly responsible for the changes in the composition of the milk fat.

Still more substantial evidence in regard to the influence of the stage of gestation on the composition of milk is furnished by a comparison of the composition on corresponding days of two lactation periods of the same cow, during one period of which she is pregnant and the other farrow.

An examination of the data available for three of the cows shows that the same shrinkage in milk flow and the same changes in the composition of the milk occurred at the end of the farrow lactation as took place at the end of the pregnant lactation, but at a somewhat later stage.

The conclusion drawn from the data presented in this paper is that gestation does not exert any direct effect upon the composition and properties of cows' milk, but that gestation may affect the composition indirectly by hastening the close of lactation, which is the important factor involved in the changes in the composition of milk as lactation advances. The characteristics of the milk as the end of the lactation approaches are high concentration of protein and fat, and frequently a lower concentration of lactose. The fat of cows' milk is characterized by great depression of the saponification value and Reichert-Meissl number, and great increase in iodine value and melting-point. In addition, data which have not yet been published are presented on the influence which gestation exerts upon the composition of human milk, indicating that under normal conditions gestation exerts no influence on the composition of mother's milk and that the marked decrease in the percentage of all the solid constituents of the milk reported by another investigator as accompanying gestation in the case of human milk has not been confirmed.

16 - **The Effect of Pepsin Whey on Calves.** — McINNIS, L. T., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 12, p. 850. Sydney, December 3, 1917.

Since pepsin has been used instead of rennet in the cheese factories of New South Wales, a breeder who had lost calves attributed their death to the use of pepsin whey as a food. For this reason the Department of Agriculture undertook an investigation to see whether there was any ground for his hypothesis. It was found that pepsin whey obtained from various cheese factories is often fed to calves without any ill effects, and is completely satisfactory in all respects, provided it is heated to at least 160° F. before use.

17 - **Swine Management in U. S. A.** — ROMMEL, G. M. and ASHBROOK, F. G., in *Farmers' Bulletin* 874, U. S. Department of Agriculture, pp. 1-38. Washington, D. C., September, 1917.

This bulletin deals with the various phases of swine production from a practical point of view, namely: feeding, breeding and management.

Some interesting data concerning weights of pigs at given ages are here reproduced.

Table I shows statistics based on information obtained from 12 practical breeders, asked to state the weights of their own pigs at given ages, and at the same time to name the weights which they considered pigs ought

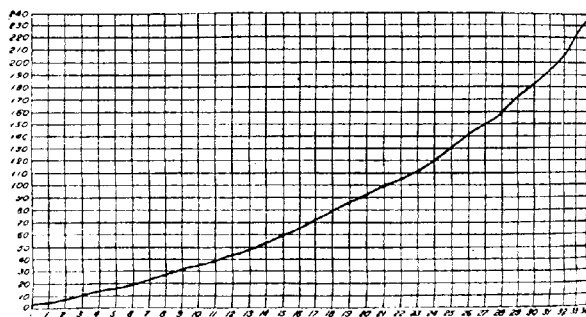
to weigh at these ages ; the aim being to establish a weight standard for swine raisers to work up to. The same table also shows the average weights of 121 pigs bred and fattened at the Bureau of Animal Industry Experimental Farm at Beltsville, Maryland. The latter weights are shown more in detail in figure 1, and it will be observed that they terminate at 8 months when the animals were marketed.

TABLE I. — *Comparison of pig weights at various ages.*

Class	Average weights (in lbs) at			
	3 months	6 months	9 months	12 months
Breeders' pigs	41	120	191	267
Experimental Farm pigs	48	140	235 ⁽¹⁾	—
Breeders' standard	63	176	293	347

(1) Weight at 8 months, when marketed.

FIGURE 1. — *Average weekly weights of 121 hogs at Bureau of Animal Industry Experimental Farm, Beltsville, Md.*



The abscissae represent the number of weeks (1 to 34) since birth (0).

The ordinates represent the live weights in lb.

448 - **Blood Fat in Domestic Fowls in Relation to Egg Production.** — WARNER, D. and EDMOND, H. D., in the *Journal of Biological Chemistry*, Vol. XXXI, No. 2, pp. 294, 10 Tables. Baltimore, August, 1917.

The work described was carried out at the Poultry and Chemical Laboratories of the Storrs Agricultural Experiment Station, Connecticut.

The natural colour of the body fat of most hens and the fat in egg yolk is yellow. This colour is due to a pigment of the xanthophyll group together with very little of a pigment isolated in crystalline form by WULSTÄDT and ESCHER and proved by PALMER to be identical with plant xanthophyll.

The disappearance of this colour from the external parts of the hen's body led the authors to undertake this investigation. There is in the hen a correlation between egg laying activity and yellow pigment. BLAKESLEE and WARNER have shown that when the yellow in the ear-lobes did not exceed 0% in a given group of hens the percentage of birds laying was high; the second percentage decreased as the first increased. They concluded that "the laying removed the yellow pigment from the body for the production of eggs more rapidly than it could be replaced by the normal metabolism". This led the authors to believe that, if the yellow pigment present in the hen's body before laying is transferred to the egg yolk, the body fat containing the yellow pigment would, in a like manner, pass in the blood from the body to the egg yolk. (It should be noted that, in this paper, by "fat" is meant the total ether extract composed chiefly of fats and cholesterol).

If this be so a hen which lays heavily should have blood much richer in fat than a hen which does not lay. The authors, therefore, studied the relationship of blood fat in fowls to:— 1) egg production; 2) the presence of food in the alimentary tract; 3) the colour of legs, etc.; 4) sex. WARNER had shown previously that the average amount of fat found in high producing and in laying hens is 1.426%, and in low producing hens 0.886%. The results were considered to justify further study. In October, 1916, the authors commenced their work with 12 cockerels and 82 White Leghorn hens. The hens had just completed their 1st or 3rd year of laying, and among them were birds with high, medium, and low records.

The egg producing records cover a period from November 1 to the following October 31. Blood samples were taken from October 28 to November 3, 1916. The results obtained were as follows:—

There is little or no correlation between the amount of fat in the hen's blood and its annual egg yield, but the blood of a hen laying at the time the sample is taken is much richer in fat than that of a hen which is not laying.

The average percentage of fat in the 70 hens which had just completed their first year of laying was 0.407; for the twelve 1½ year old cockerels it was 0.176. These data show that it is improbable that high producing hens can be selected merely by sampling their blood and determining its fat content unless account is taken of whether or not the hen is laying at the time of sampling, and also of the season. A 16 hour fast did not seem to decrease the fat content of the blood of fowls.

There is a close relation between the colour of the beak, legs, and vent and the percentage of fat in the blood. The birds with pale legs, beaks and vents had a high percentage of fat in their blood and a high average egg production, and vice versa. This shows that birds which are not laying store fat in the body cells and, consequently, their beaks, legs, and vents become yellow, the natural colour for all American breeds and Leghorns.

The average percentage of fat in the blood of the 3 year old hens was much lower than that of the 1 year old birds. The percentage of fat in the blood of the male birds was more constant than that of the 1 year old hens. There seems little difference between the percentage of fat in the blood of male birds and in that of hens which are not laying.

The principal reason why the blood of laying hens is much richer in fat than those which are not laying seems to be that the fat stored in the body tissues is taken up by the blood and carried to the egg yolk.

449 - **Second Report on the Experiments carried out at Pusa to Improve the Mulberry Silk Industry** (1).—DE, M. N. (Sericultural Assistant, Research Institute, Pusa in Agricultural Research Institute, Pusa, Bulletin No. 74, pp. 27. Tables 12. Calcutta, 1911.

CROSSING. — Multivoltine races were crossed with univoltine races to see whether a multivoltine hybrid race which will yield better cocoons than pure multivoltine races, can be established. Some success was attained. Multivoltine crosses thus obtained gave better yields than the pure multivoltine races usually reared in Bengal, Assam and Mysore. It seems that it will not be possible to get all the layings multivoltine from a hybrid race; a few eggs from each laying turn univoltine but they should be destroyed. The loss of these eggs can be ignored considering the advantages gained.

It was found that, in the case of a hybrid race, if all the yellow cocoons were eliminated from each generation, it is easy to get all white cocoons but it is difficult to get all yellow cocoons after many generations if white ones are eliminated.

The following crosses were made: — (Nistari × French) × Mysore Nistari × (Japanese-Italian); Assam × Nistari; Assam × Chotopolu Nistari × Chotopolu; etc.

USE OF STIMULANTS. — M. Kawahito, the Director of Aichikew Sericulture Experimental Station, Japan, has been reported to get an improvement in the cocoons of univoltine races by immersing the eggs in dilute hydrochloric acid. A similar experiment was carried out by the author with a multivoltine race, but better eggs were not obtained by treatment with dilute hydrochloric acid.

EFFECT OF FEEDING. — The yield of silk can be increased by increasing the number of feedings, but the advantage obtained is not proportionate to the extra trouble and cost required for the purpose. An experiment was undertaken to find out which variety of mulberry gives the most satisfactory result in the yield and other qualities of silk and the percentage of disease in the mother moths. The best varieties were found to be *Morus alba* var. *japonica* and *M. alba* var. *philippensis* (both for univoltine and multivoltine races) and then *M. indica*. The leaves of the variety *italica* are very big and hard and not suitable for feeding the larvae. The Bengal bush variety would probably give better results if it were allowed to grow into a big tree. All races yield more silk if fed with suitable mulberry tree leaves than when fed with bush leaves. Tree mulberry should be introduced in addition to bush.

RESISTANCE TO DISEASE. — a) *Pebrina*: In a previous report the author has shown that, in a climate like that of Pusa, univoltine races are more susceptible to pebrine than multivoltine ones. The disease appears

(1) For the summary of the first report, see B. 1915, No. 1071 (Ed.).

ore in May to October than in September to April. The more pebrinized layings are reared with healthy layings the less the number of cocoons are stained from a rearing. The percentage of diseased moths is more or less proportion to the pebrinized layings reared with healthy layings. Good eggs and healthy layings can be obtained from a pebrinized laying if the worms are carefully attended to and if the temperature and moisture-content of the air are suitable for the healthy growth of the larvae. Bad eggs and pebrinized layings are obtained from a healthy laying if the temperature and moisture-content are high and if the worms are not properly looked after.

b) *Flacherie*. — Many moths are attacked with flacherie during the rainy season when the temperature and moisture-content are high. It is found that eggs laid by moths attacked by flacherie, can be safely kept for industrial purposes though in some cases the cocoons are a little inferior to those obtained from eggs laid by healthy moths.

HIBERNATION. — Univoltine eggs should be hibernated for about 5 months at about 35° to 45° F. The author undertook an experiment to find out whether it is possible to shorten the duration of cold storage by increasing the intensity of cold and to study the effect of intensive cold on the embryos. The results showed that the duration of cold storage can be shortened by the action of intense cold, but that the eggs hatch quite unsatisfactorily.

As regards the indigenous races the author indicates the Mysore race as being the best for yield of silk. The Nistari race should be reared in April or May, the Mysore race and hybrid races from July to October and univoltine races from October to March. Of all the univoltine races, Chinese and Japanese races thrive best in a climate like that of Pusa but their yield of silk is inferior to those of France and Italy. The cross-breeds between Boropolu and foreign univoltine races should be reared in those places where imported foreign races do not thrive well.

30 - **Fresh-Water Mussels: Their Exploitation and Artificial Propagation in the Rivers of the United States.** — RAVFRET-WATTEL, R., in the *Bulletin de la Société Nationale d'Acclimatation de France*, Year LXIV, No. 11, pp. 427-438, 6 Fig. Paris, November, 1917.

OTHER LIVE STOCK

In the inland waters of America, there are hundreds of species of fresh water mussels (family Unionidae) many of which produce pearls much used in jewelry; for this reason, they are considerably exploited in the United States. The shells are used for making mother-of-pearl buttons. The species most in demand are *Quadrula ebena*, *Lampilis anodontoides*, *L. rectus*, *Callaciusus*, *L. ligamentinus*, *Tritogonia verrucosa*, *Plagiola securis* and *Symphynota complanata*.

For various reasons, especially over-fishing, the mussels have been greatly reduced in numbers, so much so that various measures have been proposed to remedy such a state of affairs. As these measures do not appear to suffice, the breeding of fresh water mussels is being considered.

As these molluscs pass the greater part of their larval life on fish (par-

ticularly on the gills), the latter will be of great importance in rearing the mussels.

Researches are in progress concerning the food and other needs of the fresh-water mussels, when, having left their hosts, they begin to assume adult characters.

FARM ENGINEERING.

451 - **Thé Encouragement of Mechanical Cultivation in France.** — *Feuille d'Informations du Ministère de l'Agriculture*, Year XXII, No. 52, pp. 1-2. Paris, October 16, 1917.

The French Minister of Agriculture has published an order date October 8, 1917, containing the following provisions: —

Agricultural groupings of at least 7 members, departments, boroughs may receive State grants for the purchase of machines for mechanical cultivation, provided that they undertake to use the machines themselves and to prepare for and sow cereals with a minimum per machine of an acreage to be fixed in each case, according to the capacity of the machine and the nature of the soil. When the machines acquired by the above-mentioned groups consist of a set of at least 5 tractors and material for steam or electric ploughing, the subvention (acquisition of material and advances for the cost of cultivation) may amount to 50 % of the cost of the machines. In the contrary case, the subvention may not exceed $\frac{1}{4}$ or $\frac{1}{3}$ of the cost of the machines, according to whether the applicant will have recourse or not to an agricultural credit bank. In regions that have suffered through the war, the maxima may be raised respectively to $\frac{1}{3}$ or $\frac{1}{2}$ of the price of the machines.

Applications for subventions must be made to the Minister of agriculture through the prefect of the department. They will be accompanied with the opinion of the prefect and the following information obtained and verified by the director of agriculture: — the type and price of machine; the rules relating to the conditions under which the machine is to be used; a provisional estimate for the undertaking; a report on the geological, topographical and agrogeological conditions of the region where the machine is to work; the area to be worked; the engagement provided for; the rules of the syndicate for the agricultural associations, with the number of members and the funds available indicated, the bases of the division of common expenses and charges between them; the extract of the resolution of the general or municipal council for the departments and boroughs; and, finally, proof that the applicants have suffered from the invasion.

452 - **Mechanical Cultivation Tests at Rabat, Morocco, in 1917.** — *DRESSER*, R. — *the Journal d'Agriculture pratique*, Year LXXXII, No. 3, p. 53. Paris, February 7, 1918.

The Automobile Club of Morocco has carried out tests of mechanical cultivators at Oulja de Rabat from September 26 to 29, 1917. Five machines took part, the trials being carried out on compact soils greatly hardened by drought.

The results of these trials are given in the appended table.

Machines	H. P.	Depth of work, inches	Area ploughed per hour sq. feet	Fuel used per acre	
				Paraffin gallons	Petrol gallons
AMCO . . .	24	6-7	25 192	2.59	0.22
ILL . . .	20	6-7	23 336	2.96	1.53
FD . . .	14	breaking-up stubble	—	—	3.22
LAN . . .	20	5-7	21 562	3.12	0.13
LINE . . .	12	breaking up stubble	—	—	3.18

Notes are given below as regard the ploughs, the quality of work, the best average speed in relation to the area worked per hour and the width of work.

AMCO: 4-furrow, automatic-lifting plough; width of work, 40 in.; very even work; average working speed, 8186 ft. per hour.

BULL: 3-furrow, automatic-lifting plough, width of work, 40 in.; good work; average working speed, 6775 ft. per hour.

FORD: 2-furrow plough, not self-lifting; width of work, 27 in.; breaks up stubble fairly well. The area worked per hour and the average speed were not determined. The Ford machine consists of the ordinary frame with a 14 H.P. motor converted into a tractor.

IRAN: 3-furrow, automatic-lifting plough, width of work, 35 in.; very good work; average working speed, 7992 ft. per hour.

MOINE: 2-furrow plough; width of work, 27 in. The area worked per hour and the average speed were not determined; the fuel-consumption indicated in the table is approximate.

The area ploughed per hour and the fuel-consumption per acre agree very well with the results obtained with the same machines in the trial ataisy-de-Grand, France, in 1917 (1).

B. The Application of Electricity to Agriculture in France. — DABAT, in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*, Vol. III, No. 43, pp. 1138-1155. Paris, December 26, 1918.

The author considers the present importance of the various uses to which electricity may be put in agriculture, and suggests ways of developing the extended use of electricity on farms.

Manual labour, now of increasing scarcity, should be partly replaced by machinery. Great progress has been made by using internal combustion engines and steam engines. Electricity, though already used in agriculture, is not employed as much as it ought. Electric motors have many advantages over internal combustion engines, which are much more generally used in

(1) See R., November 1917, No. 1951 and R., January 1918, No. 81. (E.A.)

agriculture and they are cheaper. However, for mechanical ploughing the electric motor is superior to the steam engine. But in spite of its qualities the electric motor may be less economical. If certain uses of energy could support the present sale prices, for many others (motorculture, threshing cereals) the price of 15 to 20 centimes the kw-hour should not be passed. For irrigation and drainage works, the tariff would have to be lower, according to the lift required. To lower the sale price, the height of which results from the small and discontinuous demand for farm use, farmers should unite in groups comprising enough members to represent current and number of working hours of importance. On the other hand, the State should intervene and use all possible means to obtain low tariffs for farmers. The energy being supplied at rates suiting the farmers, they should remove the obstacle formed by certain methods of farming so as to derive the greatest benefit from the use of electricity.

The foundation of hydroelectric works constitutes one of the most important factors in lowering the cost of electric energy. France has, in its watercourses, an enormous quantity of latent energy, estimated statistically at from 4 to 5 million HP. at low-water and 9 to 10 million at an average level; while the total nominal HP. of steam engines in France amounts to 15 million HP. It follows that the coal beds decrease every year while the water-power remains unchanged.

The adaption of watercourses for the production of electricity only dates back some twenty years. Before the war the total water power in use amounted to 620 000 HP., of which 380 000 HP. were distributed, the rest being utilised on the spot. Since 1914, the total water power employed or about to be employed, has increased by 400 000 HP.

The author quotes various technical, administrative or legislative measures taken by the Minister of Agriculture to develop the utilisation of "white coal".

From the technical point of view, the work of the "Services des Grandes Forces hydrauliques", often praised by both French and foreign scientists and engineers, will eliminate the necessity for private individual or long and costly study regarding the exploitation of watercourses.

Regarding administration and legislation, the Minister of Agriculture has drawn up rules for Communes when about to transfer their water rights and he has put forward several bills attempting to remove the hindrance caused by the present legislation to the industrial use of watercourse. To obtain reduced tariffs for agricultural work, he has obtained that the principle of reduced tariffs in favour of syndicates should be inserted in the contracts. The obligation of furnishing current at low prices is also provided for in various concessions for works on rivers of the public land conceded by the Minister of Public Works. The text of a recent bill regarding *all the categories of watercourses* not only gives concessions to syndicates, but also to *agricultural groupings of any kind*. The bill contains clauses requiring industrial concession-holders to provide reserves of water and current for agriculture and accords reduced tariffs to all agricultural groupings of general interest.

The Minister of Agriculture also helps to organise cooperative societies for the generation and distribution of energy. The State, in this case, has helped financially as well as providing for the collaboration of the technical experts of the Service for agricultural improvements. The Minister has so profited from the establishment of works founded since the war to intensify the production of chemical fertilisers. To this end, some contracts require that, for a certain period of years after peace has been declared, considerable amounts of energy shall be provided for the manufacture of calcium carbide and cyanamide.

For some years, the electrical distribution societies have completely neglected to obtain the custom of farmers. But they have finally realised that if, when commercing work, they were justified in seeking more paying customers (lighting, transport, industry), it would have been better management to seek other outlets, such as agriculture, which, by means of lowered prices, would consume that surplus energy which is often to difficult to utilise. Accordingly the distributors have decided to do propaganda work to interest farmers in the uses of electricity in agriculture. The electrical exhibition at Marseilles (1908), the international electrocultural congress at Reims (1912), the general agricultural competition of 1913, have greatly contributed to a more widely diffused knowledge of the application of electricity to agriculture. Some distributing societies addressed the farmers directly. For example, the Motive Power Society of Refrain, at Fontbeliard, should be mentioned, as it has installed electricity in several agricultural villages, under the stipulation that if the consumers were not satisfied, the current would be withdrawn and no charges made. In every case the installation has been retained.

The author thinks that the State should encourage these societies to continue in this way, by helping to form agricultural associations for using energy in common. In this way, not only would the total energy required by farmers increase, but the hours of current consumption would be greater owing to circulation established between the associations. Whilst distributing energy among the consumers to as to reduce variations of load while increasing its duration, thus playing a similar part to the syndical associations for the distribution of irrigation water, the association would reduce the concession-holders' expenses and assist development. If new lines were to be installed to supply the agricultural consumers, the association will help to equalise the charge on the capital invested by dividing it among a large number of consumers. The association has also the advantage of buying the more expensive apparatus to be used in turn by the members.

The author shows that the State rather than distribution societies should found these associations. The distributors might hesitate on account of the time and capital required and become discouraged by the set-backs always produced by attempts to unite agriculturists. The State has more powerful means of action and it should intervene all the more, seeing that these collective organs would not only be useful for furnishing energy, but would enable all sorts of agricultural improvements to be carried out: threshing in common, co-operative dairies, distilleries, etc.

The author also points out the value of State help in showing the most economic and suitable method of utilising energy, so that all possible facilities may be obtained from the distributors and full profit from the advantages given them by law. In the case where the supplying of farms would require the extension of a distribution network, and the cost would fall on the consumers, the project might be formulated by the technical experts of the Service for agricultural improvements, who would supervise the work, while the cost would be lightened by subventions and loans from State funds. This technical and financial aid would always be given to farmers whenever the utility of forming a special service for production and distribution is recognised.

It is to be hoped that the co-operative movement, first intended for the common working of farm products, with oil works, cooperative wine-cellers, and continued by the common purchase and use of threshing machines, will extend to the generation and distribution of electric energy. Thanks to the various measures now under discussion, which will be supplemented by active propaganda, the agricultural use of electricity will be rapidly developed, to the great profit of French agriculture.

451 — **Tractors in the United States.** — I. Extract from the *American Thresherman* published in the *U. S. Department of Agriculture Experiment Station Record*, Vol. XXXVII, No. 4, pp. 387-388, Table. Washington, September, 1917. — II. RINGELMANN, MAX, in the *Journal d'Agriculture pratique*, Year LXXXII, Vol. XXXI, No. 2, p. 30. Paris, January 2, 1918.

I. — Tabulated data concerning the operations of 50 large tractors and 37 small tractors during 1916-17. Fifteen of the large tractors used gasoline and 44 used either kerosene or distillate.

The relation of horsepower to work is shown in the following table:—

Rating of tractors HP.	Area ploughed in 10 hours, acres.	Rating of tractors. HP.	Area ploughed in 10 hours, acres.
5-12	6.30	15-30	11.70
8-16	6.00	25-45	19.20
10-20	7.70	30-60	21.00
12-25	9.00	40-60	25.53

II. — M. RINGELMANN observes that the figures apply to lighter soil than those in France, with more shallow ploughing, and a longer furrow length. So, to obtain figures applicable to France, M. RINGELMANN multiplies the figures given above by 0.7.

According to the report, 72 holders out of 96 stated that the work done by tractor costs less than that done by horses. On the other hand, 40 holders having tractors of over 30 HP. were in favour of mechanical traction while two years ago there were only 30 in favour. Amongst 27 holders having tractors of less than 30 HP., 33 declared in favour in the previous year, while in the present report only 30 were favourable to mechanisation.

55 - **The Conversion of Motorcars into Tractors** (1). — I. The "Shofield" Auxiliary Wagon. *Le Génie Rural*, Year X, No. 78, pp. 8-9, 3 Fig. Paris, 1918. — II. The "Tracford" Conversion Unit. *The Implement and Machinery Review*, Vol. XXXXIII, No. 513, p. 958, 1 Fig. London, January 1, 1918.

I. — The SHOFIELD Co. of Kansas City, U. S. A., have a useful device which enables a motorcar to be used as a tractor with only slight change. The device consists of an auxiliary wagon which is towed on the road by the motor car, while the latter is mounted on the wagon in the field.

When on the wagon, the car is held firmly on a two U shaped rails in which the automobile wheels engage. The back wheels of the wagon, serving as driving wheels, have each a rim with internal teeth which engage with a gear whose axle turns on a bearing fixed on the wagon; this axle carries a sprocket wheel. Another sprocket wheel is mounted on the hub of each rear wheel of the car. The two sprockets are connected by a chain. The rear of the car is lifted until the 2 chain drives are sufficiently taut; then the driving wheels of the car turn freely, the movement being transmitted to the rear wheels of the wagon. The front wheels of the wagon can be steered by a wheel placed by that of the car, but which turns vertically. According to the inventor, mounting requires about 10 minutes.

II. — Another conversion unit to enable a FORD car to be used as a tractor, is the "Tracford", sold at £ 65 by the POWER FARM SUPPLY Co., Priory Lawn Chambers, Ellys Road, Coventry.

The device comprises a pair of large tractor wheels fitted with removable strakes, and mounted on a strong axle which is attached to the rear end of the frame of a FORD car. A pair of roller pinions replace the wheels at the end of the FORD axle and these pinions gear with a series of 8 gear sections of 7 teeth each, which are bolted to the inside of the tractor wheels.

The result is a 9 to 1 reduction in the gearing, the road speed being reduced $\frac{1}{9}$, while the power delivered at the axle is increased ninefold. A supplementary water tank is mounted over the engine, and a water circulator automatically provides forced circulation through the radiator. The tractor axle forms the draw bar.

The "Tracford" unit weighs less than 800 lb.; its axle is of 1. 15-16 solid steel and the wheels have a 10-in. face with angle-iron lugs attached.

56 - **Fuel Saving.** — STRITTMAYER, A., in the *Farm Implement News*, Vol. XXXIX, No. 1, pp. 36-38. Chicago, January 3, 1918.

While the actual production of petrol in the United States is 6 849 000 gallons per day, the Bureau of Mines estimates that 1 500 000 gallons are wasted daily through various losses, such as leaky tanks, badly-adjusted buretts, motors running idle, waste in garages, etc. The Automobile Chamber of Commerce has suggested methods of economy which are quoted below:

- 1) Store petrol in underground steel tanks. Use wheeled steel tanks with measuring pump and hose. They prevent loss by fire, evaporation and spilling.
- 2) Don't spill or expose petrol to air — it evaporates rapidly and is dangerous.

(1) See R. June 1917, No. 577 and December 1917, No. 1204 (Ed.).

- 3) Don't use petrol for cleaning or washing — use other materials to remove grease.
- 4) Stop all leakages. Always shut off gas at tank or feed pipe.
- 5) Adjust brake bands so as not to drag. See that all bearings run freely.
- 6) Don't let engine run while car is standing. It is good for the starter battery to be used frequently.
- 7) Have carburetors adjusted by the makers or by automobile companies.
- 8) Keep needle valve clean and adjust carburetor (while engine is hot) to use as lean mixture as possible. A rich mixture is wasteful.
- 9) Preheat air entering carburetor and keep radiator covered in cold weather to ensure better vaporization.
- 10) Time spark correctly and drive with spark fully advanced — a late spark increases gas consumption.
- 11) Have a hot spark; keep plugs clean and spark points properly adjusted.
- 12) Avoid high speed. The most economical speed is 15 to 25 miles per hour.
- 13) Don't accelerate and stop quickly — it wastes gas and wears out tyres.
- 14) Avoid aimless and needless use of cars. Do a number of errands in one trip.
- 15) Find out the mileage per gallon. Fill tank full and divide odometer mileage by gallons consumed.

The author considers these rules at length; He points out that, with farm engines, carburetor adjustments are easily made while the engine is running, largely by watching the character of the exhaust and the noise it makes. Although the last three rules apply to motorcars, the last one is useful for a farmer using a tractor. He ought to know how much fuel the tractor uses in plowing a certain field or doing some piece of work such as filling a silo.

457 - **Fire Prevention and Fire Fighting on the Farm, in U. S. A.** — TOLLEY, H. R. and YERKES, A. P., in *United States Department of Agriculture Farmers Bulletin No. 902*, pp. 16, 1 Fig., bibliography of 11 publications. Washington, D. C., January, 1915.

Organised fire prevention is still neglected in farms, as few farmers have considered the means to adopt for preventing and fighting fires. Yet millions of dollars' worth of agricultural wealth is destroyed by fire in the United States each year. At normal prices and with an average crop, the loss is about equal to the value of the potato crop in that country. This bulletin is intended to interest farmers in fire prevention on his own premises and to urge him to eliminate all unnecessary fire hazards, while providing all required facilities for fighting fires.

The writers consider the common fire hazards and point out that, as regards the spontaneous combustion of hay stacks, the first cut of alfalfa seems to be the most dangerous in that respect. In addition, precaution should be taken in buildings where incubators, brooders, evaporators, and other equipment requiring the use of fire are housed.

Farmers' Bulletin 842 of the U. S. Department of Agriculture gives directions for installing modern lighting rods. In some instances, farmers' mutual fire insurance companies make reductions on the premiums charged on rodged buildings.

As regards methods of fire fighting, water is the simplest and cheapest fire extinguisher; pails of water should always be placed in every farm building so as to be instantly available in case of need. Water-supply system

which furnish water under pressure afford excellent facilities if the necessary hose and connection are always ready for use.

Amongst chemical extinguishers carbonic acid is that most generally used. More than 20 firms manufacture soda-acid extinguishers costing from \$7 to \$12. They are of simple construction and can throw a stream from 25 to 40 feet for about a minute. These extinguishers can be refilled and used many times.

Another type of chemical extinguisher consists of a metal syringe filled with carbon tetrachloride, a liquid that only freezes at -50° F., and which, at about 200° F., turns into a heavy vapour which covers and smothers the fire. It is very useful in extinguishing burning oil, gasoline, or kerosene, on which water or carbonic-acid gas extinguishers have little effect. An extinguisher of this type costs about \$8 and liquid for refilling it can be purchased for about \$1.50; it is approved by all fire insurance companies.

In Department Bulletin 379 of the U. S. Department of Agriculture an automatic fire extinguisher (1) for use in grain separators is described which can also be used for general fire protection on the farm when the separator is not in use. Besides these types there are also dry-powder extinguishers consisting of metal tubes filled with powder, and hand-grenade extinguishers.

It should not be forgotten that sand is a very good extinguisher of burning oil; in such a fire, water is of no use, unless applied in large quantities. Sawdust mixed with soda at the rate of a bucket of sawdust to 1 or 1 lb. of soda is a good extinguisher of oil fires, especially if the oil is in a deep container.

§ - Review of Patents.

Tillage Machines and Implements.

Canada	179 567 — 179 790 Cultivators.
Denmark	22 746 Turf dividing machine.
France	485 616 Cultivator.
	485 721 Rotary mouldboard.
	485 834 Vineyard plough with adjustable device for cultivating between the plants.
Switzerland	77 205 Motorplough.
United States	1 250 339 Agricultural implement.
	1 250 591 Land roller.
	1 250 962 — 1 251 068, Ploughs.
	1 251 198 Rotary harrow.
	1 251 324 Weeder.

Irrigation.

France	485 789 Overhead spraying apparatus.
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Manures and Manure Distributors.

Spain	9 937 Apparatus for grinding bones.
United States	1 250 981 — 1 251 372. Manure spreaders.
	1 251 225 Fertilizer distributors.

(1) See R., 1916, No. 1208. (Ed.)

Drills and Seeding Machines.

- United States 1 250 297 — 1 250 559. Seed planters.
 1 250 298 Maize planter clutch controlling mechanism.
 1 251 021 Maize planter.

Various Cultural Operations.

- United States 1 250 791 Beet chopper.

Control of Diseases and Pests of Plants.

- United States 1 250 510. Boll weevil exterminator.

Reapers, Mowers and Other Harvesting Machines.

- Canada 179 534 Stoker.
 180 054 Lawn trimmer.
 France 485 896 Fore-carriage for mowers, reapers and binders.
 Switzerland 77 080 Tightening claws for sheaf bands.
 77 206 — 77 208. Mowers.
 United States 1 250 347 Hay rake.
 1 250 737 Shock loading and unloading machine.
 1 251 373 Automobile hay rake.
 1 251 403 Corn husking machine.
 1 251 425 Pea nut harvesting machine.

Machines for Lifting Root Crops.

- Denmark 22 639 Beet topping and pulling machine.
 United States 1 250 458 — 1 251 362 Beet harvesting machine.

Threshing Machines.

- United States 1 251 187 Threshing machine.

Machine and Implements for the Preparation and Storage of Grain, Fodder, etc.

- Canada 179 671 Hay fork.
 179 780 Sheaf collector.
 180 080 Chariot.
 France 485 671 Hay loader.
 United States 1 250 334 Stacker for hay and the like.
 1 250 337 Hay loader.
 1 250 824 Hay elevator.

Traction and Steering of Agricultural Machinery.

- France 485 694 Agricultural motor.
 United States 1 250 156 Guiding mechanism for agricultural implements.
 1 250 381 Power transmission mechanism for traction machines.
 1 250 964 Draft equalizer.

Housing of Livestock.

- Switzerland 77 081 Halter.
 United States 1 250 358 Feed grinder.
 1 251 374 Hog trough.

Poultry Farming.

- Canada 179 797 Brooder.

Dairying

- Denmark 22 687 Churn.
 22 767 Butter handling device.
 Switzerland 77 243 Cheese press.

Various.

- Denmark 22 664 Water wheel.

59 - **The Construction of Poultry Houses, in U. S. A.** — SCHOTTE, W. F., in the *Montana Agricultural College Experiment Station*, Circular No. 72, pp. 49-69, Plgs. 11. Bozeman Montana, September, 1917.

FARM
BUILDINGS

The proper and comfortable housing of poultry is essential to maintain their health and vigour. Abundance of sunshine and fresh air should be provided for, and the system of ventilation should be arranged so as to remove all dampness, while constantly changing the air.

The poultry house should be so high as to allow head room for the attendant. Such low houses are less affected by outside temperatures and are more comfortable for the birds. The width of the house more or less depends upon the type of roof. For northern conditions with cold winters, the wide house is to be desired. This allows the roosts to be placed at the back and keeps the birds away from the open front. The sun shining into a wide house warms it more easily. The house should be so placed that the sun shines in at the openings every hour of the day, especially in winter. A good rule for placing windows is to allow 1 square foot of glass for every 4 birds. The author describes the different types of houses, giving all details required for the construction of a house 16 × 26 feet. The poultry house in use at the Montana Experiment Station is narrow, 12 ft. wide and with a shed roof. It has proved fairly satisfactory, but would have been better if it had been built wider. The front of each pen is provided with a door and two windows, one glazed, the other of wire netting. The wire netting can be covered with a curtain to shelter the birds against winter cold and summer heat. Each pen is made 12 × 16 ft, thus housing 12 birds. The back wall is 6 ft. and the front wall 8 ft. high. This poultry house in reality consists of a number of pens joined up in a straight line.

The details of construction of the houses, which are particularly suitable for Montana conditions, are shown in figures.

RURAL ECONOMICS.

60 - **Cost of Keeping Farm Horses and Cost of Horse Labour in the United States.** —

COOPER, M. R., in *United States Department of Agriculture, Bulletin No. 560* (Office of Farm Management), pp. 1-24, Washington, D. C., July 9, 1917.

The cost of horse labour has a bearing on the net return of every farm enterprise, but being chiefly made up of items of expense representing materials furnished by the farm and not involving a direct cash outlay is not fully appreciated by farmers who have not made a study of the subject.

This bulletin shows how the annual cost of keeping a farm work horse and the cost per hour worked may be determined, and points out that the cost per hour worked is the true measure of the profitability of a horse to its owner.

The data presented were obtained from cost-accounting records for 16 horses on 27 farms in three States, namely Illinois, Ohio and New York. The cost records kept on these farms consisted of detailed daily reports of

all labour and financial transactions, complete inventories and other necessary information for determining not only the costs and returns of farm work horses, but also the costs of operation and returns from the entire farm business.

A detailed summary of the annual average cost per horse, and the percentage of the total gross cost represented by each item for the horses studied in each State, will be found in Table I.

TABLE I. — *Detailed summary of average annual costs and credits per horse by States (37 farms, 316 horses).*

GROSS COSTS

Item	Illinois (154 horses)		Ohio (72 horses)		New York (90 horses)	
	\$	%	\$	%	\$	%
Feed and bedding	68.75	65.0	76.86	58.8	94.25	57
Labour	13.99	13.2	27.48	21.0	22.09	13
Interest	7.90	7.4	8.66	6.6	9.43	5
Stabling	4.95	4.7	7.18	5.5	12.98	8
Use of equipment	3.82	3.6	5.00	3.8	5.83	3
Shoeing	0.86	0.8	2.35	1.8	4.56	2
Depreciation	3.46	3.3	—	—	17.56	10
Net loss on colts	0.04	—	1.24	1.0	—	—
Miscellaneous	2.12	2.0	1.00	1.5	2.09	1
Total	105.89	100.0	130.67	100.0	159.81	100
CREDITS						
Manure	5.24	—	8.20	—	13.36	—
Horse appreciation	—	—	2.10	—	—	—
Colt profit	—	—	—	—	1.43	—
Total	5.24	—	10.30	—	14.79	—
NET COST						
Cost of keeping, less credits	100.65	—	120.37	—	145.02	—

These gross costs and net costs represent the average cost of the work performed by the horse. It will be seen that, with few exceptions, each item of cost was greater in Ohio than in Illinois, and still greater in New York.

This variation in average cost is discussed by the writer analytically for the different items of cost and credit.

Kinds of Feed. — The number of kinds of feed used were 11 in Illinois, 16 in Ohio and 18 in New York. In all cases the principal feeds used were maize, oats, hay, straw and pasture, representing 97 % of the total feed cost in Illinois, 94.5 % in Ohio, and 88 % in New York.

Corn was the principal grain fed in Illinois, oats in Ohio and New York. The greatest quantity of hay per horse was fed in New York, and the most pasture per horse was used in Illinois (4.93 months, against 2.26 in Ohio and 1.13 in New York).

Cost of Feeds. — In Table II the feeds are divided into three classes, namely, grain, roughage and pasture by States.

TABLE II. — *Average quantity and cost of grain, roughage and pasture per horse by States (27 farms, 316 horses).*

Kind of feed		Illinois (154 horses)		Ohio (71 horses)		New York (90 horses)	
		Average quantity per horse	Average cost per horse	Average quantity per horse	Average cost per horse	Average quantity per horse	Average cost per horse
Grain	lb.	4 500	\$14.93	3 317	\$10.71	2 691	\$8.55
Roughage	lb.	4 224	16.13	6 660	32.65	9 513	51.20
Pasture	days	148	7.69	68	3.50	34	1.50
			\$68.75		\$46.86		\$61.25

These costs are based on the values of feeds at the farm for feed raised, and on actual cash costs for feeds purchased. The price of corn in New York is, as compared with Illinois, 42 per cent. greater, and of oats 36 per cent. greater, while the price of hay is only 9 per cent. more in New York than in Illinois.

It is evident that variation in feed prices had a marked influence on the total feed cost per horse in each State.

In Table III are shown the variations in monthly feed costs on three individual farms, one from each of the three States.

TABLE III. — *Variation in feed costs, by months, on three individual farms situated in Illinois, Ohio, and New York respectively.*

Month	Illinois \$	Ohio \$	New York \$
March	8.68	7.75	7.94
April	7.65	7.39	7.68
May	7.34	8.42	10.39
June	6.66	7.30	10.68
July	7.00	7.20	7.93
August	4.70	6.50	7.76
September	4.58	6.66	7.53
October	4.32	6.29	6.23
November	4.67	5.40	6.22
December	4.40	5.70	6.56
January	4.40	5.94	6.56
February	4.23	6.42	5.92
Average	5.72	6.74	7.62

Labour costs. — Labour includes the number of hours of both man and horse labour devoted to feeding and taking care of the horses, cleaning stalls, hauling feed and supplies, and to any other labour performed for the benefit of the horse. The hauling of manure from the barn and barnyards is not charged against the horses, but becomes part of the manure not charged to the crop on which it is applied. The number of hours, cost per hour, and total cost per hours of man and horse labour devoted to the care of horses is shown in Table IV.

TABLE IV.—*Number of hours, cost per hour, and total cost per horses of man and horse labour devoted to the care of horses by States (27 farms, 316 horses).*

Kind of labour	Illinois (154 horses)			Ohio (72 horses)			New York (90 horses)		
	Hours	Cost per hour Cents	Total cost \$	Hours	Cost per hour Cents	Total cost \$	Hours	Cost per hour Cents	Total cost \$
Man labour . .	85.2	14.95	12.74	164.6	16.00	26.34	127.3	16.40	20.88
Horse labour . .	13.1	9.56	1.25	8.2	13.00	1.14	8.5	14.22	1.21
Total			13.99			27.48			22.09

Interest on value of horses. — The average value of the horses studied in this work were as follows: Illinois, \$158; Ohio, \$173; New York, \$189.

Stabling Cost. — This cost, calculated on a 5 per cent. interest on the part of buildings used for stabling horses, varied from 4.7 per cent. of the total gross cost of keeping in Illinois to 8.1 per cent. in New York.

Use of Equipment. — In Illinois this cost calculated on a 5 per cent. interest on the average investment in harness and miscellaneous equipment used by horses, both cash and labour for repairs, insurance, taxes and depreciation, was about \$4 per head and \$1 and \$2 higher in Ohio and New York respectively.

Shoeing. — On many of the farms this expenditure was of minor importance, since the horses were not shod except when needed for heavy road work or when used on frozen ground. The average cost was there fore only \$0.86 in Illinois, \$2.35 in Ohio, but \$4.56 in New York.

Depreciation and Appreciation. — In determining depreciation and appreciation in value of horses a yearly inventory value was placed on each horse on the farm by careful appraisal and a record was kept of each horse bought and sold. Table V shows the percentage of horses that appreciated in value, the percentage that did not and the factors influencing the aggregate depreciation or appreciation by States.

TABLE V.—*Percentage of 316 horses that appreciated in value, percentage that did not appreciate, and the factors influencing the aggregate depreciation or appreciation, by States (27 farms, 316 horses).*

State and number of horses	Percentage of horses that showed		Num- ber of deaths		Num- ber of horses bought		Num- ber of horses sold		Num- ber of horses bought		Num- ber of horses sold	
	Appreciation	Nonappreciation	—	—	—	—	—	—	—	—	—	—
Illinois (154 horses)	15.75	84.25	3	21	21	2	—	—	43	—	—	—
Ohio (72 horses)	21.95	78.05	—	9	17	2	1	—	7	—	—	—
New York (90 horses)	4.95	95.05	6	6	3	1	2	—	15	—	—	—
The three States (316 horses)	15.60	84.40	9	36	41	5	3	—	65	—	—	—

The average net depreciation of the 316 horses was \$4.50 per horse. Depreciation varied from \$11.60 per horse in New York, to an approx-

on of \$ 2.10 per horse of Ohio. (On 378 farms studied in Chester County, the average depreciation resulting was \$7 per head, largely determined by the practice of farmers in disposing of horses while they are still saleable at a satisfactory price. On 14 New York farms in 1912 and 31 in 1913 the average annual depreciation was found to be \$ 14.03. Of the 35 farms studied, 12 showed an appreciation of horses. In Rice County, Minnesota, depreciation varied from \$ 0.98 in 1903 to \$ 15.48 in 1904, averaging for four years \$ 5.56 per head; in Lyon County it averaged \$ 6.94 and in Norman County \$ 5.82 per head.

Profit and loss on colt account. — Of the 43 colts fed on the Illinois farms were born during the years of the survey and showed a loss of 4 cents per head, in Ohio \$1.24 per head, while on the New York farms the colts showed an average profit of \$ 1.43 per head. This survey proved that only under favourable conditions is the raising of colts one way of keeping down the cost of horse labour.

Miscellaneous costs. — Including insurance, share of taxes, veterinary prices and medicine, etc., varied from \$ 1.90 on the Ohio farms to \$ 2.12 in Illinois.

Manure. — Horses were credited with only the manure recovered from the stables and feed lot, which was valued at \$ 1 per ton before removal. The average manure credit was greatest in the States where the horses were fed the largest quantities of grain and roughage and pastured the least number of days.

Variations in net costs. — Including in one group those years for which the net cost per horse was greater than the average for the State and in another group those years for which the net cost per horse was less than the average for the State, the following differences, shown in Table VI, between the group above the average cost and the group below the average cost were obtained.

TABLE VI. — *Detailed difference in costs and credits between records showing a net cost per horse above the average and below the average. (10 farms, 154 horses).*

State	Feed (cost) \$	Labour (cost) \$	Depre- ciation (cost- credit) \$	Appre- ciation (credit) \$	Colt loss (cost) \$	Colt profit (credit) \$	All other costs \$	Manure (credit) \$
Illinois farms . . .	18.05	4.24	1.96	—	3.72	3.35	2.59	0.39
Ohio farms . . .	32.11	7.59	0.07	4.59	2.86	0.31	4.75	2.19
New York farms . .	9.41	1.68	5.13	—	0.14	3.79	8.00	1.60

Relation of the work performed to the total feed cost. — In order to show the relation if any, existing, between the total work done by a horse and the total cost of feed, which is the greatest item of cost in keeping a farm work horse, the yearly records for each State were divided into two groups with reference to the average total work done per horse. The first group contains the data for those farms on which the horses worked more hours than the average for all records in that State. The second group contains data for those farms on which the hours worked per horse were less than the average for the State group. (See Table VII).

TABLE VII. — *Relation of work done to the total feed cost by States*
(27 farms, 316 horses).

Records with work hours per horse	Illinois (154 horses; average hours worked, 1053)			Ohio (72 horses; average hours worked, 867)			New York (90 horses; average hours worked, 1020)		
	Average hours worked per horse	Average feed cost per horse	Average feed cost per hour	Average hours worked per horse	Average feed cost per horse	Average feed cost per hour	Average hours worked per horse	Average feed cost per horse	Average feed cost per hour
Above the average (1).	1200	\$75.20	\$0.063	1055	\$59.00	\$0.054	1172	\$97.30	\$0.084
Below the average (2).	880	\$67.30	\$0.077	723	\$67.30	\$0.093	863	\$85.00	\$0.083
Differences.	320	\$7.90	\$0.014	332	\$11.70	\$0.009	309	\$12.30	\$0.014

1) Records: Illinois 8, Ohio 7, New York 9. 2) Records: Illinois 9, Ohio 9, New York 9.

This table shows that there is a relation between the work done and the quantity of feed consumed per horse, but the excess in feed cost; the harderworking horses is more than offset by the extra number of hours worked by them, so that the average feed cost per hour of labour in the group was about 1 1/2 cents less on the Illinois and New York farms as about 1 cent less on the Ohio farms.

On an average on the farms studied there was a fairly uniform difference between the average feed cost and the total cost per hour of labour, showing that the number of hours worked and the feed cost per horse are the controlling factors in the total cost per hour of horse labour.

Cost of horse labour per hour. — The cost of horse labour depends on the net cost yearly to keep a horse, and the total amount of work done (Table VIII).

TABLE VIII. — *Cost of horse labour per hour (27 farms, 316 horses).*

State	Average hours worked			Average net cost per horse	Average cost per hour worked
	Per year	Per week day	Per Sunday		
Illinois (154 horses)	1053	3.30	0.40	\$100.65	\$0.0956
Ohio (72 horses)	866	2.70	0.46	\$120.37	\$0.1390
New York (90 horses)	1020	3.24	0.13	\$145.02	\$0.1422

Labour performed by months. — In each State very little labour was performed by the horses during January; February, 30 to 40 hours; about 60 hours in March. Thereafter the work increased until, during May, the maximum for any one month was reached (182 hours in Illinois, 120 in New York and 120 in Ohio). From then on to the end of the year there was a fairly uniform decrease in the hours worked per month. In New York and Illinois the increases in October and November (95 and 100 hours respectively) are due to grain threshing and maize harvest. In Illinois the greatest amount of extra horse labour was required during August, Ohio, and October in New York. This extra horse labour was usually

exchange work among neighbours, the major part being used in grain threshing, maize harvest and autumn seeding.

Table IX shows the average number of week days when no horse labour was performed, by months.

TABLE IX. — *Average number of week days when no labour was performed, by months.*

Month	Illinois (10 farms)	Ohio (7 farms)	New York (10 farms)	Month	Illinois (10 farms)	Ohio (7 farms)	New York (10 farms)
January . .	8.3	9.7	12.4	July . . .	1.2	3.1	1.5
February . .	5.8	7.0	9.5	August . .	3.8	2.1	5.3
March . . .	7.0	6.8	12.0	September .	3.0	4.0	3.5
April . . .	2.7	4.6	4.6	October . .	3.5	5.4	4.8
May	6.0	2.2	1.3	November .	1.9	3.5	5.8
June	1.1	2.5	1.2	December .	5.1	7.6	11.3
• Total . . .				48.4	58.5	73.2	

Relation of total crop acres per farm to crop acres per horse. — This relation is shown in Table X.

TABLE X. — *Relation of total crop acres per farm to crop acres per horse by States (27 farms, 316 horses).*

	Illinois (10 farms; average size 166 acres)		Ohio (7 farms; average size 74 acres)		New York (10 farms; average size 94 acres)	
	Average per farm	Average per horse*	Average per farm	Average per horse	Average per farm	Average per horse
	Acres	Acres	Acres	Acres	Acres	Acres
Farms above the average size	230.2	22.2	93.7	17.8	112.74	20
Farms below the average size	111.2	16.8	54.7	14.6	70.07	17
Difference . . .	119.0	5.4	39.0	3.2	42.67	3

From these figures it appears that the large farms permit of a more efficient use of horse labour than do the small farms. On the large farms in Illinois there were 22.2 acres in crops per horse while on the small farms there were but 16.8 acres per horse. Similar results were found on both the Ohio and the New York farms, though in these States the difference between the two groups was not as great as in Illinois.

AGRICULTURAL INDUSTRIES.

#1 - New Method for the Separation and Estimation of Lactic, Succinic and Malic Acid in Wine. — LABORDE, J., in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 23, pp. 793-795. Paris, December 3, 1917.

As the methods in general use are unsatisfactory, the author describes a new one which gives good results, not only with wines poor in sugar, but also in very sweet wines.

INDUSTRIES
DEPENDING
ON PLANT
PRODUCTS

I. — UNSWEETENED WINES. — In the case of red wines the tannic substances are first removed as follows:— 50 cc. of the wine is taken, and the acidity neutralised by a volume V of normal potash equal to the total acidity. A 5 % mercuric acetate solution is then added, avoiding an excess of mercury salts, until the tannic substances are almost completely precipitated; the mixture is heated to about 50° C. and the precipitate washed twice with warm water.

In the case of white wines this preliminary operation is necessary only if the proportion of tannin is about 1 gm. per litre; it is sufficient to neutralise the acidity of the wine with normal potash.

To the liquid thus obtained is added a volume S of normal H_2SO_4 , so that $S = V = n$; the volume n depends on the difference in the total alkalinity of the ash A expressed as cream of tartar and the alkalinity T of the cream of tartar corresponding to the tartaric acid of the wine; if T is greater than A , $n = -(T - A)$, and if A is greater than T , $n = +(A - T)$.

The solution is then concentrated in an evaporating dish until the mixture is syrupy: 5 cc. of water are added and evaporation continued to drive off the volatile acids, the dry extract made syrupy again by the addition of a few drops of water; 0.20 gm. of pure bone charcoal is added, with sufficient pure sand to divide the mass and facilitate its removal from the dish. The mixture is then poured into a conical flask, the dish rinsed with a little sand and 25 cc. of 95° alcohol, which are used to extract the free acids. To facilitate this extraction 50 gm. of No. 4 lead shot are poured into the flask which is shaken with a circular movement to divide the lumps of sand. 50 cc. of ether are added, the flask shaken, and after it has been left standing for a few moments, the solution is poured on to a flat filter, and the deposit washed three times with a mixture of equal volumes of ether and alcohol. The filtrate contains lactic, succinic and malic acid, but no tartaric acid, which remains in the deposit as cream of tartar. The liquid is distilled until only a few cc. of yellow-brown alcohol are left, which are decolourised with 0.20 gm. of bone charcoal and 10 cc. of water, filtered, and washed with tepid water. The aqueous solution of the acids is concentrated by boiling, neutralised in the presence of phenolphthalein until the pink colour caused by an excess of 0.5 cc. alkaline liquid remains for about 15 seconds in the boiling liquid. The calcium salt solution is concentrated to 8 or 9 cc., a drop of 50 % acetic acid added, and the calcium lactate separated by adding rapidly 90 cc. of 95° tepid alcohol. In this alcoholic liquid of about 85° the calcium lactate remains in solution, whereas the malate and succinate are completely precipitated. The mixture is boiled to coagulate the precipitate, and after cooling, is filtered and washed with 85° hot alcohol. The estimation of the calcium in the filtrate gives the corresponding quantity of lactic acid.

The precipitate left on the filter is treated with boiling water, which re-dissolves it completely (except for a little calcium phosphate), it is then concentrated to about 8 cc., 1 cc. of glacial acetic acid added, then 90 cc. 95° alcohol, which precipitates the calcium malate only or the malate and nitrate if the wine contains citric acid. The solution is filtered and washed

with 85° slightly acetic alcohol. The estimation of the calcium in the filtrate gives the corresponding succinic acid. By treating in the same way the precipitate left on the filter, which is re-dissolved with boiling water, the malic acid is determined.

• II. — SWEET WINES. — The wines are subjected to a preliminary treatment to separate the tannins, then acidified with normal H_2SO_4 . The mixture is evaporated till syrupy, the lead shot added, together with 10 to 12 cc. of alcohol according to the amount of sugar and finally 50 cc. of ether a little at a time, shaking the lead meanwhile. A white emulsion, which turns into a syrupy liquid is formed. After it has been left for a short time the ether alcoholic liquid is poured on to a filter, and the extraction with alcohol and ether repeated 2 or 3 times. The mixture is then distilled, and the alcoholic residue contains the soluble acids. The mixture is evaporated to dryness in an evaporating dish and the dry extract obtained treated as in the case of unsweetened wines, or those poor in sugar.

The proportion of succinic acid in normal wine is about 0.70 gm. per litre, whereas the amount of lactic and malic acid varies considerably according to the origin and state of preservation of the wine.

462 - Alcoholic Fermentation of the Jerusalem Artichoke. — See No. 399 of this Review.

463 - Characteristics and Quality of Montana Grown Wheat. — LEWIS, M. THOMAS, in U. S. Department of Agriculture, *Bulletin* No. 522, 34 pp., 13 Tables, 17 Fig. Washington, D. C., May 18, 1917.

Five distinct commercial classes of wheat are produced in Montana, which may be conveniently designated as hard spring, hard winter, western red, western white, and durum. The two first-named classes are of about the same milling quality, except that the spring wheat is decidedly superior in baking strength. The wheats of these two classes also resemble each other closely in physical characteristics and composition; both are best suited for the production of a bread flour.

The flour from the western red and western white wheat is very low in strength and absorption and has the general characteristics of other soft wheat flours. The flour is best adapted for the production of crackers and pastry products. The bread produced from this wheat is very close textured and heavy. Durum wheat is decidedly different from the wheat of any other class. Although generally yielding a high percentage of flour, the flour is usually very creamy or yellow in colour and consequently receives a low score for colour. In spite of the fact that the flour contains a very high percentage of crude protein (13.84 % in the 3-year average 1908, 1911-1912 of the analysed samples) it falls between the hard winter and western red wheats in baking strength. In water absorption the flour is slightly superior to that of all other classes. The flour from this wheat is not popular for bread-making purposes on account of its creamy colour but it is especially adapted for the manufacture of macaroni and similar products.

A comparison of the average results of tests with the wheat of the five classes is presented in the annexed table.

[461-462]

Average results of all baking tests of each of the five classes of Montana wheat.

Class of type	Number of samples	Yield of straight flour	Tests of straight flour						
			Colour of bread	Absorption of water	Strength		Crude protein in flour N \times 5.7	Moisture in flour	Crude protein in wheat N \times 5.7
					Volume of loaf *	Texture of loaf			
		per cent.	Score	per cent.	C. c.	Score	per cent.	per cent.	per cent.
Hard red spring, 5 year average, 1908 to 1912	27	71.1	98	56.4	2.342	96	11.98	10.47	12.47
Hard red winter, 5 year average, 1908 to 1912	79	71.8	97	57.1	2.142	94	11.73	9.89	12.20
Durum, 3 year average, 1908, 1911, and 1912	7	76.1	88	57.6	1.934	90	13.58	9.78	13.84
Soft red winter (Western red), 4 year average, 1908 to 1911 . .	13	68.5	98	53.6	1.787	84	10.38	10.05	11.68
Soft white wheat (Western white), 5 year average, 1908 to 1912 . .	11	66.7	96	50.9	1.756	85	9.16	9.98	10.12

(*) 340 grams of flour were used in each instance.

464 - The Catalase Activity of American Wheat Flours. — BAILEY, C. H. (Division Agricultural Bio-chemistry, Minnesota Agricultural Experiment Station), in *The Journal of Biological Chemistry*, Vol. XXXII, No. 3, pp. 539-545, 1 Table, 1 Fig. + Bibl. of 8; publications. Baltimore, December, 1917.

Nearly all animal and vegetable tissues have the power to decompose hydrogen peroxide with the evolution of molecular oxygen. This power was attributed to the action of several enzymes, till LOEW showed it depend on one enzyme only, found in all living tissues, and called by him catalase. Its action, according to LOEW, is to destroy the peroxide formed in the living cells by the action of other enzymes, called oxidases. This decomposition liberates the oxygen and isolates the radical of the peroxide. The presence of finely divided metals (spongy platinum, lead peroxide, manganese dioxide, etc.) also greatly hastens the decomposition of the hydrogen peroxide. The action of the catalase, however, shows to be an enzyme; its activity is increased by raising the temperature 1 to 1.7 times per 10°C .; in a moist medium its activity is inhibited by a temperature of 70°C ., although, in a dry medium, it remains active even 100° . Certain toxic substances, such as hydrocyanic acid, hydrogen sulphide, ammonium, metallic nitrates, etc., make it inactive. These are properties common to all the diastases.

Many authors, particularly in Germany, had already shown that the quality of flour may be judged by the quantity of oxygen liberated from the hydrogen peroxide (WENDER, LEWIN, LIECHT, RAMMSTEDT), but most of the work done in Europe has not received sufficient attention in Europe. For this reason the author wished to ascertain whether the relation between the quality of the flour and the rate of decomposition of hydrogen peroxide also existed for American flours.

APPARATUS AND METHOD. — A 500 cc. capacity flask, submerged in a water bath kept at 20°C ., is fitted with a three-holed rubber stopper; through

ne of these holes is passed a 30 cc. separating funnel, with open top, through the second a delivery tube, through the third a tube connected with a 100 cc. Hempel-Winkler burette. All the tubes are fitted with glass stopcocks, and care is taken to see that the joints are tight.

One gram of flour is placed in a mortar and triturated with about 25 cc. of distilled water. This is poured into the flask, together with the washings from the mortar, and water added till a total of 100 cc. is reached. When the mixture is at the temperature of the thermostat (26° C.), 5 cc. of a perhydrol (30% H_2O_2) solution made up of 1 part perhydrol and 4 parts water, is introduced through the funnel. When the water level in the burette is at zero, the stop-cock of the delivery tube and that of the funnel are closed, and the stop-cock of the tube communicating with the burette opened. Two readings are taken, one after 30 minutes, the other after 60 minutes. The volume of gas in the burette is corrected to 26°C. and a pressure of 760 mm.

RESULTS AND CONCLUSIONS. — The appended table shows the results obtained from many flours supplied by various mills. The ash content is expressed in per cent., and the oxygen evolved in 30 and 60 minutes respectively in cc. per 1 gm. of flour, and it is seen that, though the parallelism between the two is not exact, it is very close. With double the ash content the catalase activity increases about 340 % with treble the ash content, the activity increases about 500 %. The catalase activity, therefore, increases much more rapidly than the ash content, thus offering an advantageous method for grading flour which will dispense with the costly apparatus, — muffle furnace, platinum crucibles, etc. — generally used.

Catalase activity tests of American Wheat flours.

Mill supplying sample	Quality of flour	Ash content	Catalase activity cc. of O_2 evolved		
			in 30 minutes	in 60 minutes	
Ill A., 5000 barrels capacity	Patent (bolted at more than 70%)	0.36	6.9	11.6	
1 3 3 3 3 3	1st clear (" less than 40%)	1.04	41.1	52.4	
2 3 3 3 3 3	2nd " (" " 40%)	2.00	58.9	97.2	
Ill B., 1000 barrels capacity	83 % Patent	0.42	10.2	14.2	
3 2 3 3 3 3	100 % Straight	0.48	16.1	22.9	
1 3 3 3 3 3	17 % Clear	0.72	31.9	45.1	
Ill C., 850 barrels capacity	"A" Grade	0.49	14.1	20.6	
1 3 3 3 3 3	"L" "	0.54	16.7	26.2	
2 3 3 3 3 3	"T" "	0.93	38.4	51.6	
1 3 3 3 3 3	"E" "	1.42	72.4	86.0	
Ill D., 500 barrels capacity	80 % Patent	0.43	5.5	11.5	
1 3 3 3 3 3	Straight	0.48	12.6	19.9	
2 3 3 3 3 3	20 % Clear	0.86	30.1	43.4	
3 3 3 3 3 3	Straight	0.45	5.7	9.1	
	"	0.40	6.4	10.7	
	"	0.47	6.5	11.0	
	"	0.48	6.6	11.5	
	"	0.49	6.6	11.6	
	"	0.50	8.9	14.6	
	"	0.52	12.0	20.2	
flour bolted at 100 % from various sources					

465. - **Brazilian Oilseed.** — BOLTON, E. RICHARDS and HEWER, DOROTHY, G., in *The Analyst*, Vol. XLII, No. 491, pp. 35-45 + 1 Plate, London, February, 1917.

Brazil has a large variety of oil-bearing products. The authors have analysed many of these and have selected twenty as typical; these are given in the appended table (see p. 505). The Amazon district is particularly rich in oleaginous seeds. Those of the palms deserve special attention because: — 1) all those hitherto described give edible oils and fats; 2) the residue is suitable for feeding cattle; 3) the kernels have a high oil content and are easily shipped and do not decompose in transit; 4) in many cases the pulp surrounding the shell contains a large quantity of oil, which though usually not edible, may be adapted to many other purposes; 5) the similarity of the oils obtained from the kernels of the various palms makes it possible to mix them.

The chief disadvantages are:— 1) the hardness of the shell enclosing the kernel, which, in many cases would have to be cracked by special machinery; 2) the wide area of distribution, making collection difficult.

466 - **Paper-Yielding Plants** (1). — MICHOTTE, FÉLICIEN, in *Comptes rendus des Séances, l'Académie d'Agriculture de France*, Vol. IV, No. 4, pp. 142-146, Paris, January 30, 1917.

At the present day the paper trade is passing through a crisis of shortage of raw material which must have occurred within less than 10 years and has been hastened by the war.

Modern paper factories make use of:— 1) mechanical and chemical wood pulp; 2) by-products of spinning; 3) rags; 4) old sacks and cord; 5) alfa and its substitutes; 6) old paper; 7) cereal straw. The order of these raw materials is approximately that of the quantities of each used.

The world's production of paper amounts to about 10 million metric tons; of this 7 to 7½ million are obtained from wood alone. The shortage is due above all to lack of wood pulp, and also to lack of the six other raw materials. The real cause is that the use of wood for paper-making is a fundamental error; the increased development in the use of paper has led to an annual production which would require 10 years to produce. If progress has been made in this problem it is because little is known of plants from which paper may be made, and that the use of fibre in paper-making depends on two series of factors. One of these series relates to the fibre (ease, cost of treatment; nature of the fibre; yield in cellulose), the other to economic factors (cost, facility and labour for harvest; possibility and cost of transport; cost of fuel and soda; duties).

If the 700 known species of textile plants can yield paper, those requiring cultivation must be eliminated: only those costing nothing can be used. There are two series of such plants:— 1) those cultivated for other products such as the banana, pineapple and sugar-cane; 2) those of wild and rapid growth, classified as weeds in agriculture. Among these are— 1) Bromeliaceae (*Bromelia*); 2) Liliaceae (the *Yuccas* and *Phormium*); 3) palm

(1) See also *B. March*, 1913, No. 310. (*Ed.*)

Composition of Brazilian Palm Oils

	Weight of 100 fruits or seeds, gm.	Per-cent. of kernel	Percentage of oil			Analysis of oil (from kernels)							
			kernel	pulp	whole fruit seed	melting point	complete fusion point	solidi-fying point	saponifi-cation value	Refrac-tive index, at 4° C.	iodine value	free fatty acids (t)	unsapon-ifiable matter
<i>Elaeis guineensis</i> (from Munkos)	650	16.7	34.7	46.9	17.7	28.5°C	30.2°C	27.3°C	231.4	40.5	25.5	0.55	—
<i>E. guineensis</i> (Amazon)	320	25	36.7	19.7	12.5	28°	31°	27.8°	220.2	42.7	31.6	0.33	—
<i>Attocaryum vulgare</i>	1,900	40	43.5-54.5	37.5	21.4	29.4-30°	30.6°-32.5°	28.6°	240-345.2	36.3-37.5	12.2-13.9	0.54-1.63	—
<i>Attocaryum</i> sp.	1,250	40	38.5-40.3	negligible	17.9	33°	34°	32.5°	237.0	36.8	12.4	0.36	—
<i>Attocoma setocarpa</i>	3,300	6	53.4-64.8	63.7	18.7	21°	22°-25.8°	19.4°-24.9°	237-246	37.2-40.1	16-30	0.4-4.7	—
<i>Maximiliana regia</i>	738	12.5	60.15	—	—	26°	28.5°	—	240.9	38.5	16.56	0.33	—
<i>Coccoloba</i> sp.	1,100	40	32.1	—	—	23°	29°	26.8°	251.2	37.4	12.5	3.2	—
pointed fruits	680	41	23.0	—	—	23°	28.2°	—	—	30.2	25.4	2.97	—
<i>Attocaria fanifera</i>	1,200	—	65.7	—	—	22.2°	26.1°	22.7°	246.9	37.1	26.3	2.80	—
<i>Attocaria fanifera</i>	—	—	—	—	—	—	—	7°	191.8	52.5	76.3	0.48	1.1
<i>Myristica (Vriola) Bicunhyba</i>	131	82	69.4	—	57.9	41.7°	45.3°	40°	228.5	50.9	14.1	17.5	3.2
<i>Myristica platysperma</i>	—	—	59.5	—	34.6	41.0°	42.5°	39.8°	239.5	57.1	4.98	5.72	—
<i>Pentacetrus filamentosus</i>	435	72	51	—	36.0	—	18.4°	14.4°	177.0	52.8	68.96	0.66	—
<i>P. macrophylla</i>	700-1,800	79	50.8	—	45.3	—	—	—	155.6	57.8	100.4	0.108	1.37
<i>Carposar</i> sp.	1,855	25	70.4	—	16.2	50.5°	57°	46.2°	195.6	46.2	41.86	0.10	—
"Martina, Mulinia vegetal "	167	51	62.5	—	31.7	—	liquid	below 0°	196.3	90.3	124.1	8.7	—
<i>Pachira</i> sp.	—	82	53	—	47.6	18°-31°	40°	—	206.7	47.2	41.7	3.57	—
"Mahuburana "	—	90	70.9	—	—	40°	44°	—	245.1	41.5	20.98	22.0	4.0
<i>Garcia guianensis</i>	1,800	about	74	—	42.7	—	28° (2)	—	102.0	53.0	62.2	18.6	0.56
<i>Omphalea megacarpa</i>	1,980	76	66.75	—	50.7	—	liquid	—	191.2	58.4	31.58	0.10	0.49

(1) Expressed as lauric acid in kernel oil and oleic acid in pulp oil. — (2) Portion liquid at 15° C.

- 4) Gramineae; 5) Cyperaceae; 6) Typhaceae; 7) Juncaceae; 8) Pontederiaceae; 9) Labiatae; 10) ferns.

The cultivated plants (pineapples, bananas, etc.) and the first three above-mentioned families, cannot be used for paper-making, as by decortication a product may be obtained of much greater value than paper. The economic conditions under which the others may be utilised and new plantations of them formed requires special study.

Genera which may be used.

Gramineae. — *Ammophila*, *Ampelodesma* or *Diss*, *Andropogon*, *Arunda*, *Bambusa*, *Cynodon*, *Cynosurus*, *Dichelana*, *Epicampes*, *Elymus*, *Festuca*, *Gyncrium*, *Heteropogon*, *Hierochloa*, *Ichoemum*, *Imperata*, *Lygeum*, *Spartum*, *Melocanna*, *Michanthes*, *Molinia*, *Muhlenbergia*, *Panicum*, *Paspalum*, *Phragmites*, *Poa*, *Pollinia*, *Triodia*, *Saccharum*, *Spartium*, *Sporobolus*, *Stipa* or *Alfa*, *Thisanolaena*, *Zizania*.

Cyperaceae. — *Carex*, *Cyperus*, *Eleocharis*, *Eriophorum*, *Fimbristylis*, *Gahnia*, *Honeckena*, *Kyllinga*, *Lepironia*, *Psamma*, *Schoenus*, *Scirpus*, *Spartina*.

Typhaceae. — *Typha*.

Pontederiaceae. — *Eleocharia*, *Elodea*.

Labiatae. — *Hyptis*.

Juncaceae. — *Juncus*, *Priorum*, *Xanthorrhoea*, *Xerotes*.

Ferns. — *Polypodium*.

- 467 — Utilization of the Red Dye Obtained from the Leaf-Sheaths and Stalks of Certain Varieties of Sorghum (1). — DUDGEON, GERALD C., in *The Agricultural Journal of Egypt*, Vol. VII, pp. 150-153. Cairo, 1917.

The red pigment developed at maturity in part of the leaves and stems of certain varieties of sorghum (*e. g.*, *Sorghum technicum*) is used in some parts of northern Nigeria for dyeing goat-leather (*Bulletin of the Imperial Institute*, London, Vol. IV, pp. 75 and 366, 1906; Vol. VI, p. 175, 1908; Vol. VIII, p. 402, 1910). The sorghum used for this purpose in northern Nigeria is there called "Karandeffi"; a similar, perhaps identical, variety, "Bultan", grown in the eastern Sudan, is used for the same purpose as well as for staining grasses used in basket-making.

While cultivating several varieties of broom sorghum at El Gimmeiza Experimental Farm, it was noticed that four varieties from the United States and one from Italy all developed the red pigmentation of the leaf sheath at maturity. Red spots on sorghum stems are very common, even on *S. vulgare*, grown as a food-crop in Upper Egypt, but the active principle producing the colour is still undetermined. It has been attributed to a fungus related to that which attacks the injured parts of sugar-cane (*Circospora vaginatae*), but attempts to isolate this fungus have so far been unsuccessful, chiefly on account of the difficulty of preserving the living tissue of the plant in a sterile condition in respect to other fungi.

The colouring matter of sorghum contains two pigments: — one of a brick-red to orange-red colour, extracted by boiling in water; another of a crimson or purplish-red shade, extracted from the matter which has already yielded the first by boiling with water containing bicarbonate of soda.

(1) See also *R.* February 1918, No. 172 (*Ed.*).

It was found that an infusion of the pigment in water containing a little carbonate of soda dyed tanned goat-leather to shades varying from dark brown to black; unprepared wool was dyed a brown which did not last. An infusion in pure water dyes wool previously boiled in alum to shades of dark rose and orange-pink which fade on exposure to sunlight or dew for 3 or 4 weeks. Unprepared wool, boiled in an infusion of pure water, took up nearly all the free pigment; subsequent steeping in a solution of hyposulphide of soda fixed the dye very well. When hyposulphide of soda is added to the solution in which the sorghum is boiling, a browner shade is obtained which appears resistant to sunlight, etc. Similar results were obtained with bombyx or tussar (*Antheraea mylitta*) silk.

When zinc nitrate and tartaric acid were used to fix the dye the colours obtained with silk were very bright, varying from dark orange-red to rose pink, and were apparently fast.

When the coloured liquor is evaporated to dryness very little residue is left. This pigment may be obtained as a by-product of sorghum grown for other purposes.

58 - **A Study of Methods for Preparing Liquorice Extract.** — PICHARD, GERMAIN, in the *Journal de Pharmacie et de Chimie*, Year CX, Series VII, Vol. XVII, No. 1, pp. 16-18. Paris, January 1, 1918.

The author has tried all the official methods prescribed by the pharmacopœias of different countries, in order to find the best method of extraction so as to obtain a high yield and concentration, whilst leaving the organo-optic qualities of the extract unaffected. Percolation in the hot was also tried.

From the results it is concluded that the best method is that of percolation with cold, ammoniacal water, prescribed in the United States. Whilst percolation with pure, distilled water extracts 4 to 5 % of the glycyrrhizic acid contained in the herb, percolation with ammoniacal water removes up to 8 %, according to the author's experiments. These figures are close to those of CAPIN, who worked with Smyrna liquorice, and obtained, with percolation with ammoniacal water, a yield superior by 4.15 gm. % to that given by percolation with pure, distilled water. The author obtained his results with liquorice from *Glycyrrhiza glabra*, but of varying quality. They underwent the same variations.

In second order, comes lixiviation in the cold, and thirdly, maceration. Methods using heat, though giving a higher yield, are defective, as they cause an alteration of the chief constituent of the liquorice (glycyrrhizic acid, which is partly hydrolysed) and they should be completely abandoned.

59 - **Berry Wax.** — *The South African Journal of Industries*, Vol. I, No. 4, pp. 338-339. Pretoria, December, 1917.

The South African "berry wax" is obtained from *Myrica cordifolia*, a bush growing on the sand-drifts between Port Elizabeth and Cape Town and in the Forest Reserves of the latter district. Up to the present it has been used but little in local factories, nearly all of it being exported, the amount in 1914 amounting to 21 395 lbs., valued at £ 1 021.

A sample of the wax was examined by the Imperial Institute, which stated it to resemble "myrtle wax" derived from *Myrica cerifera*. The results of the analysis were:—

Saponification value, 215.1 mgm; iodine value, 1.06 %; acid value, 4.09 mgm; mean molecular weight of fatty acid, 236.1; melting point of wax, 40.5°C.; melting point of fatty acids, 47.5°C.; specific gravity at 99°C., 0.8711.

A firm of manufacturers estimated the value of berry wax to be $\frac{2}{3}$ that of beef tallow. It is not suitable for candle-making, but may be used for boot and floor polishes and yields a hard, white soap.

470 - Detection of Lime Used as a Neutralizer in Dairy Products. — WICHMANN H. J. in the U.S. Department of Agriculture, *Bulletin* No. 524, pp. 22. Washington, D.C. May, 1917. — Abstract in the *Annales des Falsifications et des Fraudes*, Year X, No. 10, 110, pp. 581-582. Paris, November-December, 1917.

The use of lime by central dairies before pasteurisation for the purpose of reducing the acidity of the cream before churning is spreading more and more. It is claimed that this method gives a better butter than could be obtained, without neutralisation, with the same acid cream. The author (Assistant Chemist, Foods and Drugs Inspection Laboratory, Denver, Colo.) has devised a method by which the addition of lime to cream before churning can be detected with certainty. This method consists of a very exact analysis of the ash.

It was noted that, though in many analyses of one sample there is notable difference in the total ash content, this is not so with the salt-free ash content. The difference between the salt-free ash content in triplicate analyses is less than 0.01 %. The percentage of lime may thus be estimated by the salt-free ash.

The total ash of a 10 gm. sample is first determined. In the case of salted butter the chlorides, as sodium chloride, are determined. The difference between these two determinations gives the total salt-free ash content.

The lime is estimated as follows:— The ash of 10 to 50 gm. of the sample is warmed with a known volume of decinormal hydrochloric acid. When the ash has dissolved and cooled it is titrated with decinormal sodium hydroxide in the presence of methyl orange, the alkalinity being thus calculated. Acetic acid is added in slight excess, and the calcium precipitated from hot solution with ammonium oxalate. The calcium oxalate is filtered, washed, and ignited and the calcium oxide weighed.

By this method the author analysed the ash of cream with or without lime, and salted and unsalted butter made from both kinds of cream. The results show that a maximum percentage of 25 of calcium oxide in the salt-free ash is a good working standard. All butter with less than 25% calcium oxide may be regarded as prepared from un-limed cream. If this percentage is between 25 and 28, the butter is suspicious.

In the case of salted butter, allowance must be made for the impurities in the salt used; the chief of these is calcium sulphate. If the sulphates in the ash are estimated and calculated as calcium sulphate

liable figure for correction may be obtained. If, after this correction, the percentage of CaO in the salt-free ash of salted butter is between 25 and 35, the butter is suspicious, but, before drawing definite conclusions, the salt used should, if possible, be examined; if the percentage is still above 28, the butter has been made with neutralised cream.

Attention is drawn to a method for renovating old butter, so as to make a rancid product saleable. All butters so treated give an alkaline reaction to litmus. When heated with dilute sulphuric acid they give a smell of butyric acid which shows the presence of calcium butyrate. The aqueous extracts are alkaline to litmus and sometimes even to phenolphthalein. Analysis shows the presence of free oleic and palmitic acids.

It may be necessary to distinguish between a butter made from limed cream and a butter given a "lime bath". If the alkalinity is below 20, the aqueous extract acid to litmus, and the percentage of CaO in the salt-free ash, corrected for calcium sulphate in the salt, well above 25, the butter has been made with limed cream. If, on the contrary, the butter has an alkalinity over 20, if the aqueous extract is alkaline to litmus, the percentage of CaO in the salt-free ash above 35, and if, when treated with dilute sulphuric acid, it liberates butyric acid, it is proof that lime has been added to the butter and not to the cream.

121 - **The Determination of Bacteria in Ice Cream** (1). — AYERS, S. HENRY and JOHNSON, W. T. JR., in *U. S. Department of Agriculture Bulletin* No. 503, pp. 16, 9 Tables. Washington D. C., June 19, 1917.

The authors have devised the following method of sampling and plating ice cream: — The top layer of the can of cream was taken off with a large sterile spoon; the samples were taken, in the centre and at two opposite sides, three from the topmost third of the can, three from the middle and three from the bottom third. Each sample contained about 30 grams and was removed with a small sterile scoop and placed in a sterile flask; the flasks were then placed in water at 40° C. (104° F.) for 15 minutes; the melting or melted ice cream was thoroughly shaken; 1 cc. of melted ice cream was then removed from each flask and placed in 99 cc. of sterile water at a temperature of 40° C. in order to keep the fat in a melted condition; the dilutions were made in the usual way; the agar plates were incubated at 30° C. (86 F.) for 5 days and then counted.

By this method the writers examined 198 samples from 22 one-gallon lots of commercial ice cream obtained from different manufacturers: the tabulated results indicate that bacteria in commercial ice cream are distributed quite evenly and that an analysis of one sample from a gallon of ice cream gives results which will hold for any other similar sample from the same gallon (2).

(1) See also J. A. RUDOLPH, *Present State of Dairy Industry in Canada*, B. February 1914, p. 162. (Ed.)

(2) This shows how inexact are the conclusions of previous authors: — that the distribution of bacteria in ice cream is markedly uneven, that there is great variability in the bacterial counts of different portions of the same container, and that this variability is so great that any small sample selected for analysis will not represent the whole mass of ice cream.

Storage of ice cream for 11 days in a commercial ice-cream cabinet where it is allowed to soften every day, then repacked with ice and salt and again hardened, or in a hardening room for a period of two months did not seem to cause an uneven distribution of bacteria.

In a series of from 5 to 10 samples taken directly from a large commercial freezer the bacterial counts on each sample checked within the usual limits of error of bacterial analyses.

No greater variation in bacterial counts between samples was observed when the plates were incubated at 37° C. (98.6° F.) for 48 hours than when incubated at 30° C. (86° F.) for a period of five days.

When dilutions were such that about 200 colonies were present on the plates a lower variation between counts of samples of ice cream was found than when there were 50 or fewer colonies per plate.

The variation between a series of plates made from the same sample and dilution was found to range from 7 to 26.6 per cent. Among duplicate plates a variation as high as 41 per cent. was observed. This must be remembered in connection with the fact that the variation found in these experiments between average counts of different samples of ice cream from the same gallon lot ranged, generally speaking, between 20 and 30 per cent. To this variation between duplicate plates or a series of plates from the same dilution must be added the error introduced in removing 1 cc. portions of ice cream from different samples.

When interpreting bacterial counts, differences in the number of bacteria per cubic centimeter should never be considered except in relation to the total count of each sample.

472 - Chicago Dressed Carcass Contest of Cattle, Sheep and Hogs. — *The Breeder's Gazette*, Vol. LXXII, No. 24, pp. 1081-1086. Chicago, December 13, 1917.

Producers in the United States were exceptionally keen this year to find out whether or not their high priced feed and care had turned out a first class finished product. No better opportunity is afforded the producer to get detailed and accurate results than at the carcass contest.

CATTLE. — J. GOSLING, America's best known judge of carcass bullocks, tied the ribbons on foot on twenty-two bullocks and his ratings on foot were verified by the carcass test. SWIFT and Co. dressed the twenty-two bullocks, S. T. WHITE being the carcass judge. Table I shows the results of the cattle carcass test of steer and heifer two years old and under three, and one year old and under two.

Carcass of steer or heifer two years old and under three.

Name	Exhibitor	Breed	Foot placing	Live weight	Dressed weight	Dressing	Weight carcass	Weight carcass	Weight carcass
				lb.	lb.	%	lb.	lb.	lb.
1. State's Regent.	Pennsylvania State College.	Angus	1	1135	882	66.07	73	81	21 1/2
2. Neb White Sox.	University of Nebraska.	Angus	2	1340	1031	66.35	44	99	21 1/2
3. Cressie 2d.	Purdue University	Gr. Angus	3	1410	923	65.46	83	60	19 1/2
4. Queenland.	W. B. Seeley	Angus	5	1465	1002	68.40	52	82	19 1/2
5. Harford Lad 6th.	E. H. Taylor, Jr.	Hereford	4	1650	1137	68.91	45	83	17

One year old and under two.

Pandean gr.	Iowa State College	Angus	2	1185	759	66.58	46	74	41½
Ohio's Highland Lad	Ohio State University	Angus	5	1315	855	64.53	47	73	25
Jerry	Earl Buckland	Gr. S-H	0	1175	752	64.00	65	60	24½
Pensv.	C. L. Taggart	Gr. Angus	1	1105	708	64.07	50	60	22
Black Lad.	H. D. Brent.	Gr. Angus	0	1165	764	65.58	66	63	23

SHEEP. — ARMOUR & Co. dressed 43 head of yearling wethers and lambs. It is usually the case in the carcass contest the Southdowns were given all the ribbons.

Exhibitor	Breed	Live weight lb.	Dressed weight lb.	Dressing %	Price per lb. cents.
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Dressed carcass of yearling wethers.

W. H. Miner	G. Southdown	135	83	61.4	36
W. H. Miner	Southdown	163	101	61.9	22
R. McEwan	Southdown	120	71	59.1	21

Dressed carcasses of lambs.

W. H. Miner (1)	Southdown	82	47	57.3	77 ½
Purdue University	Southdown	120	72	60.0	40
University of Wisconsin	Gr. Southdown	97	53	54.6	40

(1) Grand Champion Carcass.

HOGS. — MORRIS & Co. dressed 41 hogs. Three Berkshires topped the heavyweight class, 300 lbs. or over, there being very little difference in the uniform mixture of fat and lean.

Dressed Carcasses Weighing 300 pounds or over.

Exhibitor	Breed	Live weight lb.	Dressed weight lb.	Dressing %	Price per lb. cents.
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1. W. S. Corsa	Berkshire	473	378	88.77	21 ½
2. W. S. Corsa	Berkshire	450	352	83.77	21 ½
3. W. S. Corsa	Berkshire	512	410	82.92	20 ½

Dressed Carcasses Weighing 200 lbs. and under 300.

B. Meyers	Chester White	320	260	81.25	22
Raemclon Farms	Gr. Yorkshire	332	275	82.83	22
Raemclon Farms	Gr. Yorkshire	310	258	83.22	22

Dressed Carcasses Weighing 100 lbs. and under 200.

1. F. E. Bone (2)	Gr. Chester White	200	168	84.00	28
2. F. E. Bone	Chester White	183	151	82.51	24 ½
3. G. L. Burgess	Poland-Duroe	243	198	81.48	23 ½

(2) Grand Champion Carcass.

475 - **The Colon-Aerogenes Group from Silage.** — HUNTER, O. W. (Bacteriological Laboratory, Kansas Agricultural Experiment Station), in the *Journal of Bacteriology*, Vol. 11, No. 6, pp. 635-639; bibliography of 7 publications. Baltimore, November, 1917.

A study of silage fermentation has shown the *colon* group to be a predominating type in the early stages of ripening. Analyses of many samples of alfalfa, sugar-cane, maize and kafir forage at the time of filling the silo, gave counts varying between 1000 to 1 000 000 of these organisms per gram of fodder. Examination of various forage collected in the fields under aseptic conditions showed their presence in numbers ranging from 1000 to 100 000 organisms per gram. This shows that the common forage crops are natural hosts of the *colon-aerogenes* group, and that the large numbers found on the forage as it enters the silo are not due to contamination through handling and cutting, but represent, in a majority of cases, the actual number living in the forage.

Numerous workers have reported the presence of the *colon* group on grains, grasses and flowers, but have not agreed whether the presence of these organisms is due to faecal contamination or whether they represent a specific type characteristic of grains.

The author's preliminary investigations show that the *colon-aerogenes* group, common on forage, finds there an environment favourable to growth. Alfalfa was grown in the laboratory, all sources of contamination, except those from the soil, being prevented. Over 100 000 coli-like organisms per gram were found. The only possible source of infection from such organisms was through the root-system, which did not seem likely, or through contamination from the soil as the plants broke through, a source of undoubted importance.

The purpose of the author's experiments was to study the physiologic activities of the *colon aerogenes* groups present in silage. He studied these activities in 110 cultures divided into four groups — *Bacillus coli communis*, *B. coli-communior*, *B. (lactis) aerogenes*, *B. acidi (lactici)*. Of these cultures, 95 were isolated from various kinds of silage (53 from alfalfa, 39 from kafir, and 3 from maize), and 15 from alfalfa and kafir collected in the field under conditions as aseptic as possible.

The results showed 48.18 % of the microorganisms to be *B. (lactis) aerogenes*, 30.9 % *B. coli-communior*, 10.9 % *B. coli-communis* and 10 % *B. acidi (lactici)*. Classified according to origin by differentiation with methyl red, 79.08 % were of non-faecal strains and 20.9 % of faecal origin. All the strains represented by the *B. coli communis* and *B. acidi (lactici)* groups were faecal types, whereas those of the groups *B. coli-communior* and *B. (lactis) aerogenes* were non-faecal types. A correlation between the Voges-Proskauer reaction and hydrogen-ion concentration was observed in all cultures; all cultures with a high hydrogen-ion concentration gave negative Voges-Proskauer reaction, those with a low concentration gave positive reaction. Litmus milk was coagulated by 90.9 % of all faecal strains while 98.5 % of the non-faecal types showed only an acid reaction.

74 - **Preservation of the Roots of Jerusalem Artichoke.** — GÉMIN, JOSEPH, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 1, pp. 64-65, Paris January 9, 1918.

It is well known that, in April, the root grows, and that, in spite of all precautions, it empties and can no longer be used.

The author successfully employed the following method on his farm at Bourgain (Isère): — In March the whole harvest is gathered into a shed; the artichokes are passed through a root-washer and a root-cutter. They are then piled in empty wine casks. Before long they float in their own water; they are then weighted with a few stones and left till July or August when they are fed to livestock.

75 - **Cold Storage Butter.** — Abstract from the *National Food Magazine*, U. S. A., in *Cold Storage*, Vol. XXI, No. 238, pp. 10-11, London, January 17, 1918.

The preservation of the flavour of butter during cold storage has been the subject of close investigation by Dr. DON C. DYER, chemist to the Dairy Division of the U. S. Department of Agriculture. Dr. DYER'S experiments show that the disagreeable flavours which arise in butter during cold storage result from a chemical change, caused by the slow oxidation of one or more of the non-fatty substances of the butter-milk; they are not due to oxidation of the fat itself. Moreover, the extent of this chemical change is in proportion to the acidity of the cream with which the butter is made. Dr. DYER overthrows certain accepted chemical theories. He believes that olein, which forms 35 % of the non-volatile constituents of butter fat, oxidises with great difficulty, and, probably, absorbs no oxygen whatever. For this reason the fault must be searched for elsewhere.

It is the butter-milk which, according to Dr. DYER, supplies the substance which decomposes during cold storage, and this decomposition is in proportion to the degree of acidity of the butter; the higher the acidity, the greater the decomposition. In order to avoid this decomposition, the dairyman who makes butter for cold storage must not use cream which is too acid, or, if he is obliged to do so, he must wash the butter well so as to free it, so far as possible, from the butter-milk. Butter made from fresh cream of low acidity is best for preserving, and at the present day, in the United States, all butter for the navy must be so made. Butter made with acid cream is suitable for immediate consumption, but not for cold storage. Navy butter was obtained as a result of a series of churning experiments on cream of various degrees of acidity. The degree admitted in the trade is from 0.5 to 0.6 % or even more. Butter as ripe as this is not suitable for cold storage, whereas the experiments showed butter having an acidity of from 0.2 to 0.3 % to keep perfectly. The United States navy butter meets the following requirements: — it must be made with pasteurised cream containing not more than 0.234 % of acid; it must not contain more than 3 % of water; the salt content must be between $2\frac{1}{2}$ and $3\frac{1}{4}$ %. This butter is stored at a temperature of 60°F. or less.

PLANT DISEASES

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

476 - Fungi, Insects and Animals Injurious to Cultivated Plants in Norway in 1916
Schröven, J. H., in *Aarsberetning angaaende de offentlige foranstaltninger til landbrugsfremme i Aaret, 1916*, pp. 39-94, 24 Figs. Christiania, 1917.

The plant pathology service in Norway is in the hands of a specialist entomologist helped by a specialist in mycology, so that, by a rational distribution of the branches of the work, results of increasing utility may be obtained. The central Bureau receives from all over the kingdom information on the appearance of diseases and injurious insects or animals; the material received is examined and instructions and information necessary to control pests of agriculture are given.

In 1916 the Director visited repeatedly the various districts and municipal agricultural centres, either to superintend the methods of control or to give lectures on questions and branches of plant pathology. The visits numbered 104 in all.

A course of 82 hours on plant pathology was also given at the Høyskolen School of Agriculture, Christiania.

The law of July 21, 1916, gives detailed regulations regarding the importation of seeds and nursery plants, the isolation and disinfection of infected districts, the distribution of fungicides and insecticides, and the duties of the officers charged with superintending the execution of the law. By this law are considered injurious to agriculture in Norway: *Puccinia graminis* ("sortrust"), *Synchytrium endobioticum* ("potetkraeft"), *Sphaeria rotheca mors-uvae* ("stikkelsbaerdraeperen"), *Tarsonemus fragariae* ("potetbaermidde"), *Euthrips pyri* ("paerens Blaerefot"), *Dendrolimus pini* ("furuspinderen"), *Lymantria monacha* ("nonne").

The reports received at the Central Bureau in 1916 numbered 110 and are distributed as follows:

Diseases attacking.	Caused by		
	Insects or other animals	Bacteria and fungi	Other causes
agricultural and market garden crops	90	117	9
fruit trees	163	94	31
berry-bearing shrubs	54	90	11
ornamental plants	35	15	7
bees, etc.	77	2	—
parasites of man and animals	28	—	—
vergreens	48	35	28
exotic trees	29	9	12
<i>Total</i>	524	362	98

The number of reports received from each district were: Smaalenenes, 58; Akershus, 292; Buskerud, 76; Jærlsberg and Larvik, 49; Hedemarken, 108; Christiania, 42; Bratsberg, 88; Nedenes, 35; Lister and Mandal, 63; Stavanger, 29; S. Bergenhus, 102; N. Bergenhus, 41; Romsdal 6; S. Trondhjem, 23; N. Trondhjem 27; Nordland, 14; Tromsø, 8; Finnmarken, 4.

The most important data are given below, mention being made of the pests reported for the first time in Norway, and those already known here which have caused serious damage to agriculture in special districts.

CEREALS. — Larvae of *Tipula oleracea* ("kaalstankelbenet"), on barley and oats at Fyrisdal; larvae of *Hydrellia griseola* ("kornbladflue") on oats in the Trondhjem district; *Oscinella frit* ("fritflue") on oats and barley at Saetersdalen and at S. Land; *Cecidomyia aurantiaca* ("orangegul hvetemy") reported for the first time as injurious in Norway, where it was found in wheat fields at Dilling (Smaalenenes district). The two common aphids *Aphis avenae* ("havrebladlusen"), *Macrosiphum granarium* ("kornbladlusen") and *Thrips denticornis* ("blacrefølter") did ever-increasing damage.

Among the fungi are mentioned the common species of *Ustilago*, *Tilletia*, *Puccinia*, *Erysiphe*, *Pleospora*, etc. The decree of September 3, 1916, gives measures for controlling *Puccinia graminis* by destroying plants of *Berberis vulgaris*.

POTATOES. — *Synchytrium endobioticum* ("potetkraeft") appeared in 1914 in the Kristiansand district in two localities near Grimsnec; by order of the Department of Agriculture the infected plants were immediately uprooted and the soil disinfected with a 1% formalin solution, and it was strictly forbidden to plant tomatoes or potatoes in the infected zone for at least 6 years. In spite of these precautions the disease spread in 1915 and was reported from 27 other localities. From this moment the government spared no efforts to suppress this pest; it gave special facilities for the purchase of disinfectants, held lectures, distributed pamphlets, and finally issued the decree of September 8, 1916, which, besides regulat-

ing the control, imposed penalties on those farmers who, instead of co-operating with the State, attempted to evade the law. At Selbusstrand considerable damage was also done to potatoes by *Limax agrestis* ("aker snegl").

VEGETABLES. — *Barynotus squamosus* caused huge losses in cabbage at Grytten, in the district of Romsdalen. To the author's knowledge this species, common in Europe, never did damage there, but imported into Canada, it ranks in that country amongst the insects most injurious to young cabbage plants.

At Stavanger, carrots suffered from the attacks of *Pseudomonas destructans* ("hvitraate"). All the varieties of carrots are not equally subject to *Pseudomonas*; while the Greystone variety is very easily attacked "hvite maiturnips" is very resistant.

FRUIT TREES. — The winter 1915-1916, which was exceptionally severe, did considerable damage to trees, thus decreasing their resistance to insects and fungi which, together with adverse meteorological conditions during flowering, contributed to compromise seriously the crop. Larvae of *Euthrips pyri* ("paerens blaerefot"), which appeared in Norway for the first time in 1914, were frequently reported in 1916 as doing damage to fruit trees. For the moment the damage is slight, but as this insect is already known to be very injurious in North America, it is best to look for it and to take measures to destroy it immediately it appears. The mixture recommended consists of:—

4 % tobacco juice	¼ litre
Water	380 "
Soap or	6 ½ to 15 ½ lbs
Paraffin emulsion	8 ¾ litres

The mixture is applied three times: — 1) when the buds begin to swell; 2) when the inflorescences begin to open; 3) immediately after the flowers fall.

Sphaerotheca mors-uvae ("stikkelsbaerdraeperen") has spread considerably of recent years in the southern and eastern provinces of Norway and has done serious injury to gooseberry plantations. The decree of September 8, 1916 makes it obligatory for orchard owners to report this disease; it is moreover, strictly forbidden to plant gooseberries in the districts of Finnmark, Tromsø, Nordland, Nordre Trondhjem, Søndre Trondhjem, Romsdal, and Nordre Bergenhus. In the experiments with different fungicides carried out by the State entomologist on behalf of the Department of Agriculture were used: —

1) a 0.4 % formalin solution (1 litre of 40 % formalin solution in 1 hectolitre of water); 2) 0.8 % formalin solution (1 litre of 40 % formalin solution in 50 litres of water); 3) 1.6 % formalin solution (1 litre of 40 % formalin in 25 litres of water); 4) sulphur-lime mixture (30° Beaumé, 25 % sulphur), 1 litre in 10 litres of water; 5) 55 % nitric acid, 2 litres in 1 hectolitre of water; 6) a 4 % sodium chloride solution with a little lime. Six plots were chosen, one being used as control. The efficacy of the fungicide was est-

nated by the number of healthy plants expressed in percentage of the total number of plants in each plot. The results obtained were :

1.6 % formalin	87.50 % healthy plants
0.8 % "	81.25 % " "
Sulphur-lime mixture.	78.13 % " "
Nitric acid	53.13 % " "
Sodium chloride solution	50.00 % " "
0.4 % formalin	31.25 % " "
Control plot	14.29 % " "

The best results, therefore, were obtained with 1.6 % formalin.

177 - **Fungi of Eritrea and Abyssinia.** — BACCARINI, PASQUALE, *Annali di Botanica*, Vol. XIV, Pl. 3, pp. 117-140. Rome, 1917.

The list includes 110 fungi isolated at different times by different botanists, chiefly in Eritrea, but also in Abyssinia. There are many species new to science, and several are new to the country explored; others, which had already been reported there are now given as existing in new districts.

The following should be noted : —

- 1) *Melampsora Ricini* Pass., on leaves of *Ricinus communis*, β *africanus*, at Nefasit (Eritrea);
- 2) *Puccinia Pruni-spinosae* Pers., on leaves of peach at Asmara (Eritrea);
- 3) *P. purpurea* Cke., on leaves of dhari and *Pennisetum spicatum* at Uchiro (Eritrea);
- 4) *Ustilago avenae* (Pers.) Jens. var. *levis* Kell. and Sw., on *Avena abyssinica*, at Asmara;
- 5) *U. Hordei* (Pers.) Kell. and Sw., on *Hordeum* sp., at Asmara;
- 6) *Sphacelotheca Sorghi* (Link) Clint., on dhari in Eritrea (Uchiro, Carabat, Hari-Ichi, Addi-Cajè) and in material from the Ruspoli expedition without any indication of locality;
- 7) *Graphiola Phoenicis* (Moug.) Poit., on *Phoenix* sp. at Asmara; on *Ph. dactylifera*, at Archico and Embatecalla; on *Ph. abyssinica* at Aidereso;
- 8) *Exoascus deformans* (Berk.) Fuck., on leaves of peach at Asmara;
- 9) *Sclerospora macrospora* Sacc., on maize, at Ghinda (Eritrea);
- 10) *Phoma Baldratii* n. sp., on stems of *Euphorbia Tirucalli*, at Addi-Ugri; fungus evidently parasitic;
- 11) *Septoria Dianthi* Desm., on leaves of *Dianthus Caryophyllus*, cultivated at Asmara;
- 12) *S. graminum* Desm., on leaves of *Hordeum* sp., at Asmara;
- 13) *Cercospora Raciborski* Sacc. and Syd., on leaves of *Nicotiana* sp., at Cheren;

Mention is also made of *Bacillus Oleae* (Arc.) Trev., on leaves of rose-hay grown at Addi-Ugri.

178 - **The Resistance of Peanuts to *Sclerotium Rolfsii*.** — MCCLINTOCK, J. A., in *Science*, New Series, Vol. XLVII, No. 1203, pp. 72-73. Lancaster, Pa., January, 18, 1918.

Already in 1916 the author had collected at the Virginia Truck Experiment Station, Norfolk, Virginia, data concerning the difference between

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peanut varieties in their sensibility to attacks of peanut-wilt (*Sclerotium Rolfsii*).

The soil of the plots in which the rotation experiment with this plant was made was known to be thoroughly infected by *Scl. Rolfsii*, and the Valencia variety had proved very subject to the attacks of this fungus. For this reason the Valencia variety was not included in the rotation experiment, its place, for the 1917 crops, being taken by commercial seed of the Virginia Bunch variety. Two plots were used for the 1917 crops; in one peanuts had been grown continuously since 1910, but in the other only in 1911 and 1914.

The two plots were observed up to harvest time (November 9, 1917). During this time a faded Virginia Bunch plant was found in each. An examination of the lower part of the stem showed the presence of mycelium of *Scl. Rolfsii*, proving the disease to be due to this fungus as in many cases in 1916.

The fact that none of the Virginia Runner plants faded confirmed the data of 1916 which showed this variety to be practically immune to wilt.

The resistance of the Virginia Bunch variety was much more marked in 1917 than in the preceding year. Whereas, in 1916, 60 out of 132 plants died in 1917 only 2 out of 7 000 plants in the same soil were attacked by the disease.

These data are of practical value, especially in the south of the United States, where the peanut is being grown to an increasing extent in districts infested with boll-weevil (*Anthonomus grandis*), and where *Scl. Rolfsii* is already a serious parasite of many crops.

479 — On a Sudden Outbreak of Cotton Rust (*Aecidium Gossypii*) in Texas.— TAUBENHAUS, J. J., in *Science*, New Ser., Vol. XLVI, No. 1185. pp. 267-269. Lancaster, Pa., September 14, 1917.

In 1917 an outbreak of cotton rust (*Aecidium Gossypii* E. and El) occurred in different parts of Texas. The author's attention was first called to it on June 10, 1917, and the first specimens were collected at Mercedes and Edinberg.

The disease is characterised by round spots of varying size on the leaf of the plant. The aecidia develop on the upper part of the leaf. The disease seems to attack first the lower leaves, and especially well-developed plants on which the cotton bolls are already large. The bracts of the plants may also be affected, but the disease has never been found on the stem.

In his herbarium Dr. J. C. ARTHUR has specimens of this fungus collected by HEALD and WOLF at Falfurrias, Texas, on September 2, 1900 and two Mexican collections, one from San Jose del Cabos (September 1893), the other from Tlahualilo, collected about 1907, probably by HERRERA. Dr. W. A. ORTHON also has specimens of this rust, collected at Miami, Florida, and others from Falfurrias and other parts of the Rio Grande valley, collected seven years ago. This shows that *A. Gossypii* was already present in Texas and elsewhere although it did not attract the attention of cotton-growers or pathologists.

Nothing definite is known as to the origin to the 1917 outbreak. Studies

re now being made with the object of determining the plant host of the perfect form (*Puccinia*) of this rust.

80 - **Vegetable Parasites of the Cacao Tree in the State of Bahia, Brazil.** — See No. 493 of this Review.

81 - **Diseases and Pests of the Onion in Illinois, U. S. A.** — See No. 422 of this Review.

82 - **A Phyllachora of the Royal Palm in Cuba.** — JOHNSTON, J. R. and BRUNER, S. C., in *Mycologia*, Vol. X, No. 1, pp. 43-44, 1 Plate. Lancaster, Pa., January, 1918.

Recently while examining specimens of royal palm (*Roystonea regia* (L.) near Rincón (Cuba), the authors noticed on the midribs of the leaves, conspicuous black, charcoal-like masses of a fungus, several centimetres long. The masses were composed of more or less confluent groups of stromata developed beneath the epidermis of the host. The fungus was also present in the leaf segments, but development there was much less considerable than on the midrib.

An examination of the fungus showed it to be a *Phyllachora* (family Botrydiaceae), which appeared to be distinct from the other species already described. It is distinguished from the other species living on palms, especially by the large size of its asci. The authors describe it here under the name of *Phyllachora Roystoneae*.

Hitherto this pyrenomycete has only been observed on a few palms and does not seem to do serious damage.

83 - **An Unidentified Fungus Injurious to the Conifer *Cedrus Deodara* in India.** — GLOVER, H. M., in *The Indian Forester*, Vol. XLIII, Nos. 11-12, pp. 498-499, 1 Plate, Allahabad, 1917.

A fungus which, according to the author, has not yet been identified, does great damage to *Cedrus Deodara* in the young regeneration plantations of the driest districts of the Bashar Division. So far as is known it does not exist where there are marked differences in rainfall.

The plants are attacked when about 1 ft. in height; those growing in the shade die first.

The plants attacked have a characteristic appearance. They are covered with spots; as a rule the leaves of the lowest branches turn brown first and die, the other branches being then infected. Sometimes the highest branches are attacked first and develop green spots; dying and dead leaves are seen on them at the same time. Sometimes the tree resists the attack, and large plants are found the lowest branches of which have been killed, the others remaining healthy; but more often the young seedlings and plants are completely killed.

If the roots are carefully examined, a yellowish-white mycelium is found, which seems to show that the fungus attacks the tree by the roots.

Up to the present the only method of controlling this fungus consists in cutting down the diseased trees, but the result has been unsatisfactory. Probably a more efficacious method would be to clear the ground so as to allow the young *C. Deodara* to develop under more favourable conditions. Control is necessary, for the disease threatens to do most serious damage in the regeneration districts, i. e., those obtained after the regular regeneration pruning of 1905-1907.

WEEDS AND PARASITIC FLOWERING PLANTS

484 - **Some Farm Weeds in Sindh, India.** — KAZI, A. M., in *The Poona Agricultural College Magazine*, Vol. VIII, No. 3, pp. 179-182. Poona, January, 1917.

Owing to the canal system of irrigation it is possible to grow crops of "kharif". As a result of the irrigation and absence of suitable cultural methods all the fields are infested with weeds, no precautions being taken to eradicate them. The only method adopted is to cut the weeds when they are sufficiently high and to feed them to livestock.

A list is given of some of the common weeds of the province, together with a short descriptive note on each of them.

1) *Eragrostis cynosuroides* Beauv. ("dubh"); 2) *Eleusine aegyptiaca* Desf. ("mandhani"); 3) *E. flagellifera* Nees ("gandheer"); 4) *Cynodon Dactylon* Pers. ("chabar"); 5) *Panicum colonum* L. ("savri"); 6) *Andropogon annulatus* Forsk. ("dinuhi"); 7) *Cyperus rotundus* L. ("kabah"); 8) *Cleome viscosa* L. ("dhanar-kbathuri"); 9) *Digera arvensis* Forsk. ("lulur"); 10) *Euphorbia hypericifolia* L. ("kherol"); 11) *Tribulus terrestris* L. ("sarang").

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

485 - **Observations on British Coccidae** (1). — GREEN, F. E., in *The Entomologist's Monthly Magazine*, Vol. LIII (3rd. Ser. Vol. III), No. 642, (35), pp. 260-263, 2 figs., No. 643 pp. 265-269, 2 figs. London, November-December, 1917.

This fourth contribution includes the following species: —

1) *Physokermes abietis* Geoffr., abundant at Camberley on some small spruces and on many other spruces in the neighbourhood;

2) *Gossyparia ulmi* Geoffr.; the young Cornish elm (*Ulmus campestris* var. *cornuliensis*) upon which the insect had been previously found, had been transplanted into the author's garden, where he was able to observe the life cycle of the insect; another small colony of *G. ulmi* was found by Mr. FRYER on a golden elm (*U. Dampieri* var. *aurea*) in a nursery at Knap Hill;

3) *Eriococcus devoniensis* Green; the author received from Dr. Dore typical samples of this species taken at Newchurch Common, Delamere, Cheshire, although this is the third locality only — the other two were Budleigh Salterton, Devonshire, and Camberley, Surrey — from which *E. devoniensis* has been reported, it probably exists wherever cross-leaved heather (*Erica tetralix*, not *E. cinerea* as stated in the original description) grows freely (3).

4) *Rhipersia halophila* Hardy, found at Camberley on roots of grasses under stones.

(1) See R. Oct., 1917, No. 975. — (2) See R. June, 1916, No. 796. — (3) See B. Aug. 1915, No. 867 (Ed.)

5) *Pseudococcus nipae* Mask., the author received from Mr. Fyler six specimens of this species from *Kentia* sp. at London; later it was also found at the Royal Botanic Gardens, Kew (1);

6) *Ps. walkei* Newst., found by Mr. H. Donisthorpe at Coring Woods;

7) *Ps. longispinus* Targ., on bananas bought at Camberley;

7.1) *Ps. longispinus* Targ. var. *latipes* n. var. on a fuchsia in a greenhouse at Camberley; other specimens have been collected at Manchester, where they infest the cactus-houses.

8) *Ps. newsteadi* n. sp., on beech (*Fagus sylvatica*) at Camberley; males, presumably of the same species, were found by Mr. E. G. JOSEPH on unopened leaf-buds of beech at Charltridge, Bucks;

9) *Aspidiotus lataniae* Sign.; the author has specimens of this coccid taken on *Dracaena* at Tooting in 1899; this species has apparently not yet been recorded from the British Isles;

10) *Lepidosaphes gloveri* Pack.; this species, which has not previously been reported in British lists is often found on the rind of imported oranges;

11) *L. desmidioides* n. sp. on *Nephrodium* sp. in the Royal Botanic Gardens, Kew;

12) *Kuwania gorodetskia* Nasonov (2); after having reported this species on birch at Camberley in 1914, the author did not find it again till June, 1917, when it reappeared in some abundance; three dead and partially decayed males were found in the woolly material of the ovisacs, but it is doubtful whether they really belonged to this species; they had none of the special characters common to the males of other *Margarodinae*, but were more like those of a *Pseudococcus*; should these males be proved really to belong to the *gorodetskia*, the species must be removed from the genus *Kuwania* and returned to the genus *Steingelia*, which, in its turn, must be moved from the sub-family *Margarodinae*; the apparent disappearance of the insect for two years may possibly indicate an unusually prolonged nymphal period.

16 - Animal Pests of Cultivated Plants in Norway, in 1916. — See No. 476 of this Review.

17 - African Aphididae. — THEOBALD, FRED. V., in *Bull. Ent. Res.*, Vol. VIII, Pts. 3-4, pp. 273-301, 15 Figs. London, February, 1918.

The author deals particularly with the following species, many of which are redescribed for the first time as being new to science:—

1) *Macrosiphum dahliaefolii* n. sp., on leaves of *Dahlia* at Kampala (Uganda);

2) *Aphis durantae* n. sp., on main and secondary veins, particularly on the upper surface of *Duranta* leaves, at Ghezireh (Egypt);

3) *A. zizyphi* n. sp., at the extremities of young shoots of *Zizyphus jama-Christi*, at Gizeh (Egypt);

4) *A. ficus* n. sp., abundant on leaves of *Ficus Sycomorus*, especially on those attacked by the Sycamore Fig Tree *Psylla*, in Egypt (Cairo, Gizeh), and in Uganda (Kampala);

(1) See *R. Oct.*, 1917, No. 976 — (2) See *B. Aug.*, 1915, No. 887 (*Ed.*)

- 5) *A. tamaricis* n. sp., on *Tamarix* sp., at Gizeh; this is the only species reported on this plant;
- 6) *A. bauhiniae* n. sp., on leaves of *Bauhinia*, at Gizeh;
- 7) *A. buddleiae* n. sp., abundant on leaves of *Buddleia madagascariensis*, at Cairo;
- 8) *A. mathiolae* n. sp., on ornamental stocks, at Ghezireh;
- 9) *A. mathiolellae* n. sp., with the preceding species, in the same district;
- 10) *A. pruniella* n. sp., on plum tree, at Nairobi (British East Africa);
- 11) *A. pomonella* Theobald, on apple tree, in the same district;
- 12) *A. pheidole* Theobald, associated with ants (*Pheidole* sp.) at Mwenegera (Rhodesia);
- 13) *A. acetosae* Koch (not Linn., Fabr., Buckton), on *Rumex* spp. and *Papaver* spp., at Ghezireh; the same species has been found in England (Wye, Kent), and in Germany;
- 14) *Siphocoryne* (*Aphis*) *pseudobrassicæ* Davis; Prof. DAVIS of Lafayette (Indiana) informed the author that he received this species from the Cape from Mr. LOUNSBURY; it lives on *Raphanus sativus*, *Brassica Rapa* var. *depressa*, *B. Napus*, *B. oleracea* var. *acephala*, *Sinapis*; DAVIS reports it at Geneva (New York), Evansville (Indiana), Lafayette and College Station (Texas);
- 15) *Hyalopterus insignis* n. sp., in colonies on the lower surface of leaves of *Arundo*, at Ghezireh;
- 16) *Myzus pterisoides* n. sp., on fern, at Kampala.

New districts and hosts are mentioned for the following species:

- 1) *Rhopalosiphum dianthi* Schrank, on *Brassica oleracea* and *B. oleracea bullata major* in large numbers, with *Aphis brassicæ* L., at Cairo and Ghezireh;
- 2) *Aphis* (*Siphocoryne*) *brassicæ* L., on the same hosts in the same districts, with *R. dianthi*;
- 3) *Hyalopterus pruni* Fabricius (*Hyal. arundinis* Fabricius, *Hyal. phragmiticola* Oestlund), previously reported from Cairo, on *Prunus* spp. and *Arundo*; recently found at Ghizch in abundance underneath apricot leaves and also on *Arundo*; the effect of the aphid is more marked on leaves of peach than on those of apricot; the author himself never found this species on either peach or apricot trees in England, but received from Woodbridge (Suffolk) living species taken from apricot trees.

488 - "4 F", a Variety of Cotton Resistant to Insect Attack in the Punjab, India. - See No. 419 of this Review.

489 - The Control of Locusts in Cyprus. - See No. 376 of this Review.

490 - Patents for the Control of Plant Pests. - See No. 458 of this Review.

491 - *Tylenchus penetrans* n. sp., a New Nematode Parasite of Cotton, Potatoes and other Plants. - COBB, N. A., in *The Journal of Agricultural Research*, Vol. XI, No. 1, pp. 27-33, 5 Figs. Washington, D. C., October 1, 1917.

Under the name of *Tylenchus penetrans* the author describes, as a species new to science, a nematode which, already in 1911, he found to be injurious

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to roots of *Viola* spp. at Rhinebeck, New York. It has been reported as a parasite of Upland cotton at Millington, North Carolina, and at Statesboro, Georgia, of potato roots near Kalamazoo, Michigan, and of *Cinnamomum Camphora* roots at Orlando, Florida.

The presence of the nematode may easily be recognised externally by the presence on the roots or tubers of small, abnormal lesions, a few millimetres in size; these are sometimes in the form of blisters, but more often in that of discoloured, slightly depressed spots. Each of these diseased spots, when fully developed, contains about fifty *T. penetrans* in various stages of growth.

The fact that this parasite is found under such varying climatic conditions and on such different hosts, shows that it is a species which adapts itself to most diverse conditions.

Nothing definite is known of the extent of the damage caused by *T. penetrans* to cotton and camphor, but the damage to *Viola* spp. is known to be very great. Information collected with reference to the potato shows the injury often to be considerable, so that great care must be taken to use only perfectly sound seed potatoes.

Mercuric chloride, used against potato scab (*Oospora Scabies*), has been found to reduce the vitality of the insect to a considerable extent.

492 - **Animal Pests of Onions, in Illinois.** — See No. 422 of this Review.

493 - **Insect and Vegetable Parasites of the Cacao-Tree in the State of Bahia, Brazil.**

TORRENT C., in *Boletim*, *Série de Vulgarização Científica*, Vol. XV, Pt. 6, pp. 263-279, 1 figs. and *Série Botânica*, Vol. XV, Pt. 3, pp. 106-127, 1 fig., 4 Plates. Braga, 1917.

The State of Bahia has for some years been the principal centre of cacao-tree production. The last statistics show it to come immediately after the English Gold Coast Colony. The cacao-tree producing district occupies a large part of the south of Bahia, between latitudes 14° and 16° in the midst or in the place of huge virgin forests.

In view of its importance this crop has become one of the chief sources of revenue of the State. The news, therefore, that hitherto unknown diseases were appearing in the Ilheos and Itabuna plantations caused great alarm, and the government immediately nominated a Commission to study these diseases; the author was president of this Commission. The investigations showed the diseases to attack both the fruit and foliage of the trees.

Among the diseases of the fruit are: —

i) that commonly known among growers as "ferrugem" (rust), caused by *Physopus rubrocinctus*. The innumerable small holes made by the larvae of this thysanopteron, which forms numerous colonies on the fruit, cause an abundant secretion of the subepidermal tissues which eventually covers the whole surface of the fruit with a thin rust-coloured or brick red layer, making it impossible to recognise the ripe fruit at the time of harvest. The simplest preventative method of control would be to crush the colonies of the insect, after the fruit attacked has been completely and carefully surrounded with the hands. The use of insecticides is difficult

(1) See R. 1917, No. (Ed).

because of the size of the plantations. An enemy of this insect whose action seems very efficacious is an ant, commonly known as "caçarema", belonging, perhaps, to the species *Dolichoderus bituberculatus* (1), which should be protected and propagated, contrary to the custom adopted up to the present ;

2) numerous black spots, about 2 mm. in diameter, which cause more or less deep cancerous formations, and, generally, drying up of the green fruit. This disease is due to holes made by a hemipteron, closely resembling *Helopeltis antonii* (2), called provisionally by the author and Dr. ZEHNTNER *Mosquilla vastatrix*, because they believe it to be identical with the insect known to Ecuador planters as the "mosquilla" (little fly). Besides using a torch for burning the insects on the fruit, it is advisable to propagate the "caçarema" which probably destroys the eggs of this hemipteron; the female insect, perhaps instinctively, never lays its eggs near this ant.

3) a kind of rot characterised either by numerous spots, isolated at first, but converging later, or one single spot, yellowish or dark brown at first, then black, which begins at one extremity and finally covers the whole fruit. This rot is usually caused by *Phytophthora Faberi*, more or less associated with other microorganisms. To control this disease care must be taken to avoid lesions on the fruit, to burn or bury the remains of fruit, as when they decompose in the air they form a seat for cryptogamic diseases. Care must also be taken to air thoroughly the infected parts of the plantation and to cut and burn contaminated fruit.

All the diseases which cause the leaves and young buds to dry up are known locally as "queima" (burn), but the causes are numerous, and among them the following may be specially mentioned :

- 1) the action of the adult *Physopus*, which pricks the young leaves;
- 1) the holes made by *Mosquilla* in the buds and young leaves.

To control these pests, in additions to the methods already mentioned it is advisable to keep the plantation well shaded ; the trees attacked should also be strengthened by rational lopping.

In the district examined the presence of epiphytic phanerogams and various species of fungi, largely saprophytic, was noticed. A fungus which should be specially mentioned is *Corticium lilacino-fuscum*, which lives on the green branches. Attention should also be drawn to a mycelium called by English workers "thread blight", which in every way resembles the mycelium of certain *Corticium*. It appears in the form of long threads on the branches and leaves ; the leaves are eventually enclosed in a sort of network and gradually dry up.

The chief cause of the diseases observed lies in the little care planted took of their large plantations in the past. To this must be added the use of unsatisfactory tools for the harvest and cultivation of the plants. The result is a large number of lesions which open the road to cryptogamic invasion. Another factor is also the atmospheric and climatic changes produced in these districts of recent years, due especially to the clearing of the virgin forests.

(1) See R., Dec., 1917, No. 1256 — (2) See R., June 1917, No. 614. (Ed).

94 - *Euxoa excellens*, a Little Known Cutworm, in British Columbia. — GIBSON, ARTHUR, in *The Canadian Entomologist*, Vol. XLIX, No. 12, pp. 402-403. London, December, 1917.

In British Columbia the larvae of *Euxoa excellens* Grt. have been so abundant in certain years that they have seriously damaged many varieties of vegetables. This species was first reported in 1885, when it did much damage in market gardens around Victoria, Vancouver Island. Larvae were so collected in British Columbia in 1888. In 1903 the insect was again troublesome on Vancouver Island, but, from that date it was not reported till May 30, 1916, when it was found at Sechart near Vancouver. The larvae had damaged various vegetables, in some gardens spinach, lettuce, onion, etc. had to be sown three times before the end of May.

Larvae received at Ottawa in June, 1916, pupated early in July. Three specimens which pupated on July 2, produced moths on July 29 and 30. Other moths emerged in August. In the collections at Ottawa are three specimens reared by FLETCHER in 1885 from larvae collected in May; the dates of emergence were August 15, 18 and 22 respectively. According to the author's observations the moths of *E. excellens* fly, in British Columbia, in the latter half of August and during September. The insect, which was first described from Vancouver Island specimens, is widely distributed; it is found in the United States, in the States of Oregon, Colorado (in September) and in California (in September and October). Nothing definite is known of the early life history of the species; the winter appears to be passed in the egg stage; in certain seasons hibernation may also occur in the young larval stage.

After describing the mature larva, pupa and moth, the author adds that, from the larvae reared at Ottawa in 1916, were obtained several haemonid parasites belonging to the species *Amblyteles subfuscus* Cress. and *Amb. nuncius* Cress; both species emerged in August. A large percentage of the larvae were destroyed by the fungus *Sorospora uvella* (T.).

Treatment at Sechart with the well-known mixture of bran, Paris green and molasses gave very good results. By this method 95 to 100 % of the larvae was destroyed. Untreated plants were completely eaten up by the insect, which did not touch those to which the mixture had been applied.

95 - *Insects Injurious to the Cranberry in the United States* (2). — SCAMMELL H. B., in *United States Department of Agriculture, Farmers' Bulletin No. 860*, pp. 45, 39 Figs. Washington, D. C., 1917.

Commercial cranberry (*Oxycoccus macrocarpus*) growing is an intensely specialised industry, confined to certain districts of the United States, specially Massachusetts, New Jersey, Wisconsin, Long Island, and part of the north-western coast of the Pacific, near Columbia.

A morphological and biological description is given of the insects attacking the cranberry, most of which are also of economic importance for other plants, together with the most satisfactory measures of control.

The list includes: —

(1) See R. June, 1917, No. 641. — (2) See R., April, 1910, No. 470. (Ed.)

- a) Insects attacking the leaves :
- 1) *Rhopobota vacciniana* Pack. (blackhead fireworm) ;
 - 2) *Peronea minuta* Rob. (yellowhead fireworm) ;
 - 3) *Gelechia trialebamaculella* Cham. (red-striped fireworm) ;
 - 4) *Dasyneura vaccinii* Smith (cranberry tipworm) ;
 - 5) members of the *Geometridae* family (spanworms) ;
 - 6) *Cirphis unipuncta* Haw. (army worm) ;
 - 7) *Laphygma frugiperda* S. et A. (fall army worm) ;
 - 8) *Systema frontalis* Fabr. (cranberry flea beetle) ;
- b) insects attacking the fruit : —
- 1) *Mineola vaccinii* Riley (cranberry fruitworm) ;
 - 2) *Eniglaea apiata* Grote (cranberry blossom worm) ;
 - 3) *Scudderia texensis* S. and P. (cranberry katydid) ;
 - 4) grasshoppers — especially *Schistocerca alutacea* Harr. and *Melanoplus bivittatus* Say -- and members of the *Gryllidae* family (crickets) ;
- c) insects attacking the stem : —
- 1) *Crambus hortuella* Hübner (cranberry girdler) ;
 - 2) *Phylloscelis atra* Germar (cranberry toadbug) ;
 - 3) *Amphisepea bivittata* Say (cranberry vinehopper) ;
 - 4) *Clastoptera proteus* Fitch (cranberry spittle insect) ;
 - 5) *Pseudococcus adonidum* L. (mealybug) ;
 - 6) *Aspidiotus ancylus* Putnam (Putnam scale) ;
 - 7) *Lepidosaphes ulmi* L. (oystershell scale) ;
- d) insects attacking the roots : —
- 1) *Rhizadapterus picipes* Oliv. (cranberry rootworm) ;
 - 2) other coleoptera, especially *Phytalus georgianus* Horn., *Dyscinetus trachypygus* Burm. and *Lachnosterna grandis* Sm. (white grubs).

496 — **Important Pecan Insects Pests and Their Control** (1). — GILL, JOHN B., in U. S. Department of Agriculture, Farmers' Bulletin 843, pp. 1-48; Figs. 1-59. Washington, D. C., September, 1917.

The pecan (*Carya olivaeformis*) industry has developed rapidly in the south of the United States. This development has, however, been accompanied by a notable increase in the number and in the destructiveness of the insects attacking the crop. The loss from insect attacks amounts to hundreds of thousands of dollars annually and, in the absence of preventive measures, is certain to increase.

This bulletin gives the results of work done by the Bureau of Entomology on the most important insect pests of the pecan. The morphology and biology of each insect are described and the most efficacious means of control given.

The following species are discussed : —

a) Insects injuring the nuts : —

- 1) Pecan nut case-bearer (*Acrobasis hebescella* Hulst.) ;
- 2) Pecan shuckworm (*Laspeyresia caryana* Fitch) ;

(1) See also R. Sept., 1917, No. 834. (Ed.)

- 3) Pecan weevil (*Balaninus caryae* Horn) ;
- b) Insects injuring the foliage and shoots : —
- 1) Pecan leaf case-bearer (*A. nebulella* Riley) ;
 - 2) Pecan cigar case-bearer (*Coleophora caryae-foliella* Clem.) ;
 - 3) Pecan bud-moth (*Proteopteryx bolliana* Sling) ;
 - 4) Fall webworm (*Hyphantria cunea* Drury) ;
 - 5) Walnut caterpillar (*Datana integerrima* G. and R.) ;
 - 6) Hickory phylloxera (*Phylloxera caryae-caulis* Fitch) ;
 - 7) Little hickory aphid (*Monellia caryella* Fitch) ;
- c) Insects injuring the trunk and branches : —
- 1) White ants; of these *Leucotermes flavipes* Kollar is the most widespread and common in the eastern States ;
 - 2) Oak or hickory cossid (*Cossula magnifica* Strecker) ;
 - 3) Flat-headed apple-tree borer (*Chrysobothris femorata* Fab.) ;
 - 4) Red-shouldered shot-hole borer (*Sinoxylon Xylobiops basilaris* Say) ;
 - 5) Belted chion (*Chion cinctus* Drury) ;
 - 6) Hickory twig-girdler (*Oncideres cingulatus* Say) ;
 - 7) Oak pruner (*Elaphidion villosum* Fab.)

The pecan is not immune to attacks from scale insects, but on account of the limited infestation up to 1917 they are not included among the most important pests of this tree.

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The Bureau assumes no responsibility with regard to the opinions and the results of experiment outlined in this Review.

The Editor's notes are marked (Ed.).

